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FOR ALL WORKMEN, PROFESSIONAL AND AMATEUR.

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THE ARTISTIC TREATMENT OF HAMMERED METAL.

BY F. ROPER HALIDAY.

THE combined arts of chasing and embossing, the means by which the ductile metals are decorated with raised or beaten ornament—*repoussé*, beaten up, as the French name the process—are of the remotest antiquity. The Egyptians were past-masters in the art of working the precious metals, and in the time of Moses the candlesticks and altar vessels used in Jewish worship were covered with beaten work.

The various examples of *repoussé* work which have come down to us are stamped in a marked manner with the individuality of the producers, and the characteristics of the times in which they lived. Volumes might be written on this fascinating subject, but the object of this paper being the practical one of indicating the means whereby students may, at a small cost, obtain

Fig. 6.—Shield (German) of 16th Century. (Diameter, 21½ in.)

a moment at the grace and beauty of what is called the Classic period. At this time humanity was deified; all the beauty of the human form was developed. Hercules was distinguished by his robust frame and massive limbs; Apollo by his graceful shape. Venus and Juno disclosed the loveliness of feminine beauty, while all that was ornamental in style and beautiful in form reached the highest degree of excellence.

An example of this period is shown in Fig. 1—a patera or tazza from the Hildesheim collection. In this example the Goddess Minerva, the initiatrix of agriculture, leans one hand upon a curved staff, in which has been recognised the primitive plough. The draperies and all the parts in relief have been gilt, whilst the ground and the flesh have been left of the colour of silver. In the same way, the light and elegant palms which adorn the neck of the patera, in relief so low as to allow the figure to predominate, are raised in gold, upon

Fig. 3.—Tankard and Cover (German) of 17th Century. (Height, 7½ in.; diameter, 5½ in.)

Fig. 1.—Patera (Roman) from Hildesheim Collection. (Diameter, 9¾ in.)

suitable examples for their own use and private study, and of giving some instruction in the use of the tools and appliances necessary, I will confine myself to a few cursory remarks on some of the principal styles.

Modern design, it has been said, is entirely retrospective, and imitative of some one previous style adopted as a model.

Bearing this in mind, let us look for

Fig. 4.—Tankard and Cover (German) of 17th Century. (Height, 12½ in.; diam., about 6 in.)

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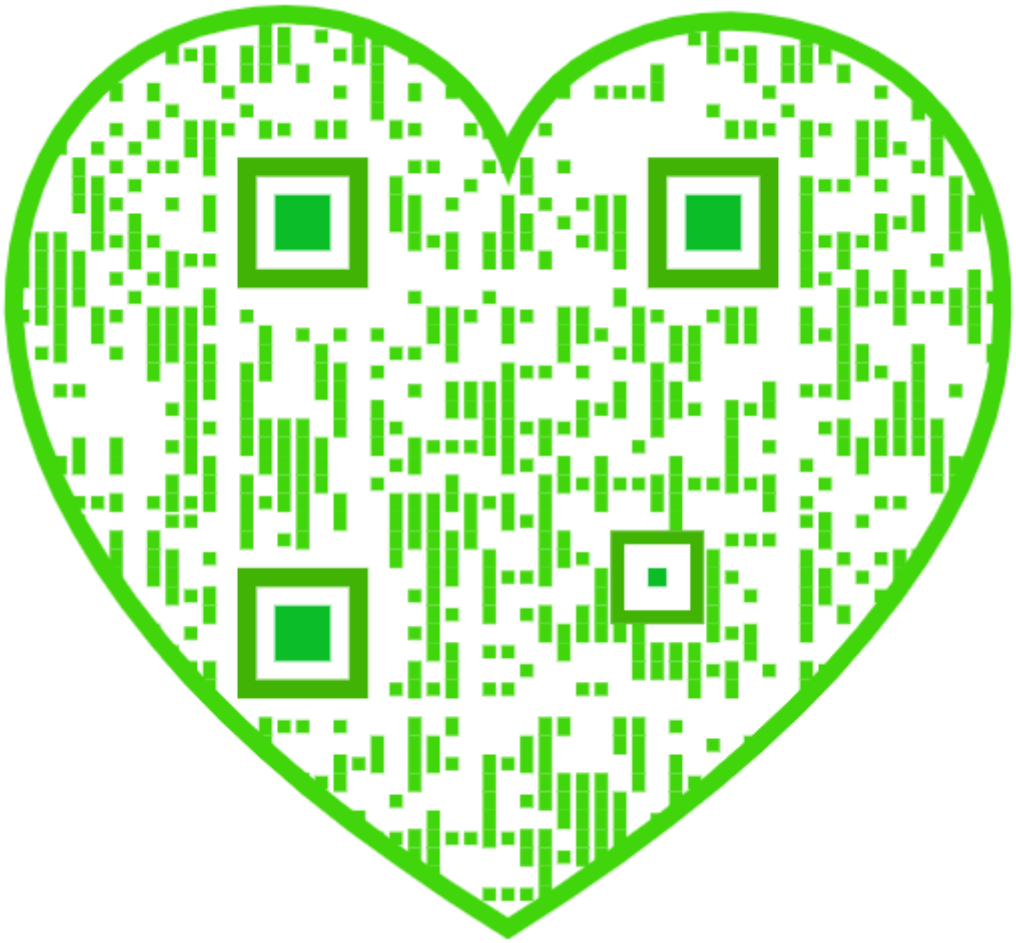

the unwrought ground of silver; an arrangement of the most happy effect, which is still more marked by the light which strikes with various intensity upon every part, according to the difference of relief. It is singular to note the resemblance which this figure bears to that of Britannia on our copper coinage.

After the Classical period came the Gothic, which for our purpose it is unnecessary to touch upon. Upon the decay of the Gothic arose the Renaissance, or, as it may be called, the resurrection of Classic art, modified of course by the different religion which then prevailed, and by the other circumstances of the time.

The Renaissance arose in Italy during the 15th century, where it was in general use nearly a hundred years before its adoption by other countries. Its chief characteristics are the embodiment of Classic details with previous styles. Mr. Digby Wyatt says—

"A remarkable feature in the Renaissance artists was their combination of the talents of sculptor and architect, from which cause figures, foliage, and conventional ornament were so happily blended with moulding and other structural forms, as to convey the idea that the whole sprang to life in one perfect form in the mind of the artist." Examples of this period are given in Figs. 2, 3, and 4.

Fig. 2 is a salver, embossed with wide scroll foliage border, from South Kensington Museum. French; date, 1698.

Fig. 3, a tankard and cover, decorated round the base and on the sides with perforated *appliqué* work. The cover surmounted with a cockatrice. German; 17th century.

Fig. 4, a remarkably fine tankard—*repoussé* work: Mercury and other mythological figures surrounded by foliated scrolls and fruit. German; date, 1605.

Of the Moresque, and other styles originating in Mohammedan countries, it may be said that they follow the precepts of the Koran, no representations of the human figure or of natural objects being allowed, hence the ornamentation is purely linear. This work is often interspersed with inscriptions, usually of a pious character.

No. 5 is a good example of the English style of the last century. It is a chocolate pot on three legs capped by satyr masks, with festoons, flowers, foliage, and bands of beading; date, 1777.

Lastly, to show the effective manner in which figure subjects are grouped on a curved circular surface, is given the example No. 6, a shield, designed and made for Diana of Poictiers, and presented by her to Henry II. of France. Now in the possession of Prince Karl of Prussia. German; 16th century.

At the Art Congress held at Edinburgh in November last year, the council of the National Association for the Advancement of Art and its Application to Industry appointed a committee of artists to select suitable examples of the artistic treatment of hammered sheet metal, for the use of "Home Art" students and others, and after careful study of numerous specimens, the following thirty-two objects were selected; they form what is known as the "Edinburgh Set," and are published by Messrs. Elkington and Co., to whose courtesy I am indebted for the foregoing illustrations.

Fig. 5.—Chocolate Pot and Cover (English), 18th Century. (Height, 12⅞ in.; diameter, 5½ in.)

They are produced in copper, and, as they are prepared by the electrotype process, give the exact form of the originals, the minutest mark being reproduced. The sizes and published prices are here given, in order that students may select such examples as they think suitable:—

1. Portion of antique vase from Hildesheim Treasure, silver *repoussé* (Berlin), 15¾ in. long. 40s.

2. Bowl with twisted lobes in hammered silver, English, 17th century (South Kensington Museum), 10 in. diameter. 50s.

3. Dish for eggs, from Hildesheim Treasure. Hammered silver (Berlin), 10½ in. diameter. 20s.

4. Portion of beaker, scale pattern, Russian, 16th or 17th century, silver (South Kensington), 10¾ in. long. 8s.

5. Foot of candlestick, Italian, 17th century, brass (S. Kensington), 5¾ in. diam. 8s.

6. Small plate, *repoussé*, with floral design, silver, 7½ in. diameter. 6s.

7. Salver, English, Queen Anne period, silver (South Kensington), 9 in. diameter. 15s.

8. Paten with Tudor rose, English, Hall mark 1562–3 (South Kensington), 10½ in. diameter. 15s.

9. Bratina, Hungarian (?) 14th century, silver *repoussé* (Buda-Pesth), 6 in. diameter. 20s.

10. Silver bowl or plate, French, about 1330 (South Kensington), 7½ in. diameter. 15s.

11. Four specimens of Ashantee ornament, gold *repoussé*, 4 in. diameter. 20s.

12. Brass bowl, Moresque (South Kensington), 10¾ in. diameter. 15s.

13. Bowl in hammered silver, Rhodian or Venetian (South Kensington), 9¾ in. diameter. 15s.

14. Antique head of Medusa silver (Berlin), 3¾ in. diameter. 6s.

15. Portion of cover of cup, with bosses, German, 6 in. wide. 5s.

16. Silver salver, *repoussé*, French, 1618 (South Kensington), 13½ in. diameter. 20s. This is shown in Fig. 2.

17. Plate, Malay workmanship, 11¾ in. diameter. 15s.

Nos. 1 to 17 are especially recommended for beginners. The following are more ambitious:—

A. Dish, brass *repoussé*, Flemish, 17th century (Musée Cluny, Paris), 2 feet 2 in. diameter. 40s.

B. Figure of Minerva, from antique silver patera, Hildesheim Treasure (Berlin), 7 in. diameter. 15s. This is the centre of the patera, Fig. 1.

C. Medusa head from shield, iron *repoussé*, Italian, early 16th century, (Musée d'Artillerie, Paris), 10½ in. diameter. 18s. A good example of bold and effective treatment.

D. Portion of cuirass, iron *repoussé*, Italian, 16th century (St. Petersburg), 9½ in. across. 12s.

E. Portion of antique silver cup, found at Herculaneum, a charming example of Classical art (Naples), 5½ in. high. 10s.

F. Small plaques, gold *repoussé*, antique Greek, and Greco-Scythian (St. Petersburg), 2 in. each. 15s.

H. Border of salver, chased silver, Irish, 1784–5 (South Kensington), 9 in. diameter. 15s.

J. Portions of cup and cover, silver *repoussé*, German, 16th century (St. Petersburg), 5 in. diameter. 20s.

K. Portion of silver vase, English, about 1770 (South Kensington), 4½ in. 8s.

L. Frame in silver *repoussé*, French (?) 17th century (South Kensington), 8 in. long. 10s.

These examples, when silvered or gilt, form very handsome decorative pieces for drawing-room, dining-room, or study.

Many of the specimens, it will be noticed, are from the Hildesheim Treasure. A few words about these may be interesting.

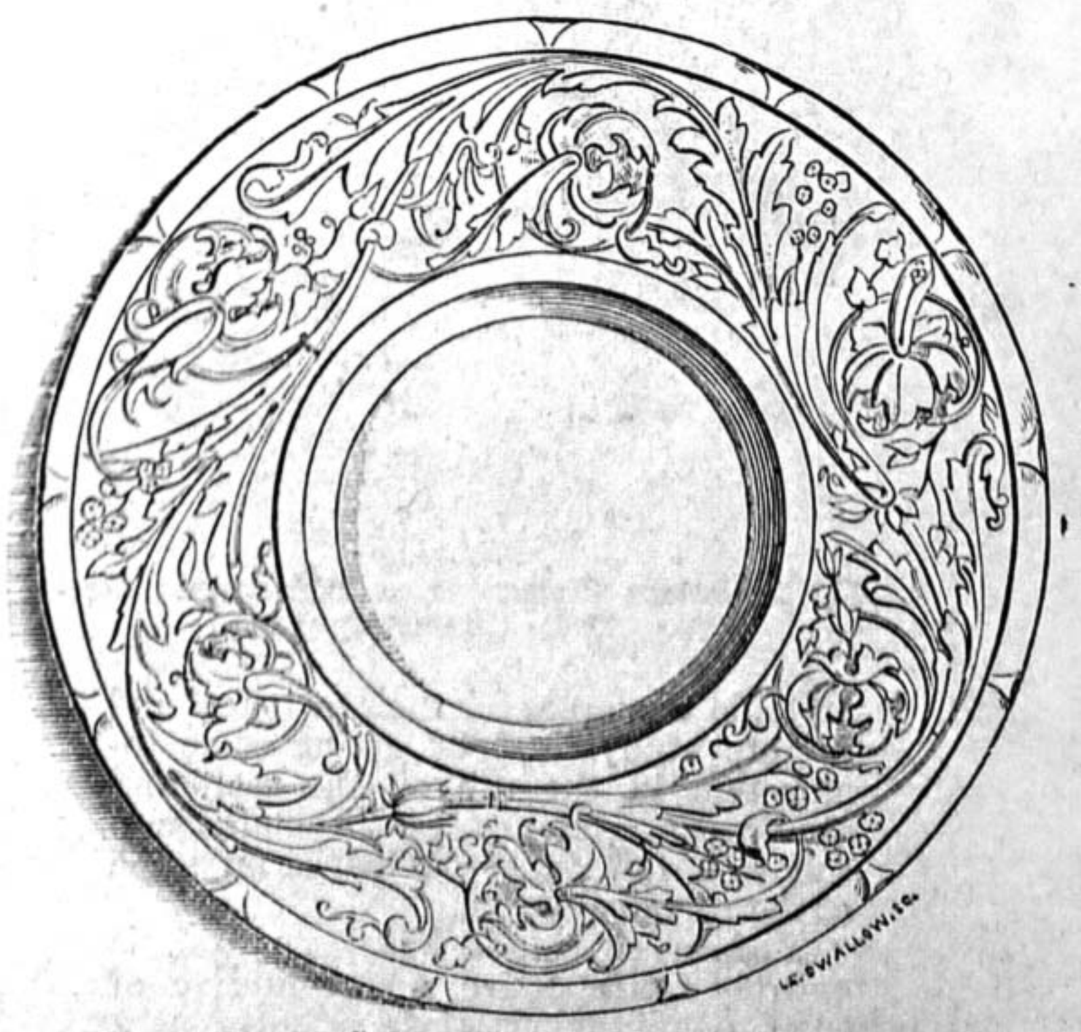

Fig. 2.—Salver (French), 17th Century.

In October 1868, some Prussian soldiers, working at the foundation of a firing butts on the slope of Mount Galgen, which overlooks the town of Hildesheim, came across some fragments of metal at the depth of about three yards, which proved to be of silver, blackened by age. An officer coming up, caused a search to be made, and they then found, beneath two large, overturned,

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bell-shaped vessels, a variety of articles, and numerous fragments, the whole having suffered greatly by damp and corrosion.

The treasure, having been carried to the barracks, was entrusted to a sculptor of Hildesheim, who restored the former appearance of the various articles. By careful scrutiny he could distinguish, through the marks which the solder had left beneath or on the sides of the cups, etc., the form and size of their feet and handles, and could replace these accessories. They are all now in the Berlin Museum, and are called the Hildesheim Treasure. They have been proved to be of antique Roman workmanship, probably dating from the second century of our era, and several of the pieces bear the names of the Roman silversmiths. They are supposed to be the booty of some barbarian robber chieftain, who vanquished one of the Roman Legions at the break up of the empire, and comprise a wonderful variety of artistic vessels, together with solid silver stewpans, and other domestic articles of the precious metals, in use during the time of the Roman emperors.

Chasing is especially suitable for home work, and regarded as an occupation—a means of gaining a livelihood—is at present in high favour. Fashions run in cycles, and the plain severity of the Queen Anne style, as adapted to objects of daily use, such as tea services, dish-covers, and the multitude of smaller articles, is rapidly giving way to the renaissance of chasing; the result being that chasers are in great demand, wages have risen considerably, and competent men are sure of plenty of employment at good rates.

The advantage of this occupation is that it is suited to all capacities. The ordinary workman with no soul above his daily labour, and with an "off on the drink" interlude occasionally, can obtain work whenever he chooses, while for the art workman, the man who can draw well, and who takes advantage of the many educational advantages at hand to cultivate his talents, the scope is practically unbounded. One has only to mention such names of world-wide fame as Ghiberti, Cellini, Morel—men who have advanced metal working to the dignity of a high art—to see the possibility of distinction in this line. One of Morel's works, the Milton Shield, illustrating "Paradise Lost," was purchased by the Government some years ago for £2,500, and is now in the South Kensington Museum. In this, as in other branches of the fine arts, a knowledge of composition and of the proportion of the human figure are of paramount importance.

The process, briefly described, is as follows. The pattern, or design, is first drawn with pencil on the surface to be decorated, and then with a snarling iron the prominences are raised from the back. The snarling iron, Fig. 7, is a long rod, the upper end, which reaches into the tankard, or other object, being curved; the rod slides through an iron ball B, and is fixed firmly in the vice, the ball resting on the top, as shown. The work is now pressed against the curved end of the rod, which is struck with a hammer at A, the effect being that the vibrations of the rod raise the prominent parts to the desired height. The work is now filled with a mixture of pitch, with a little resin and plaster of Paris, poured in hot, and when quite cold, is ready to be operated on from the front.

The jug, dish-cover, or whatever article is being operated upon, may now be said to be solid; the pitch having hardened, gives stability to the article, and yet yields sufficiently to enable the metal to take the impressions of the various punches with which the work is finished from the face.

This solid block is now laid on a sand-bag, and a cord passed round it, through a hole in the bench, and under the foot of the operator, who can now work with ease, the cord holding the article firmly, while the sand-bag prevents undue vibration.

Some of the punches used are shown in Fig. 8.

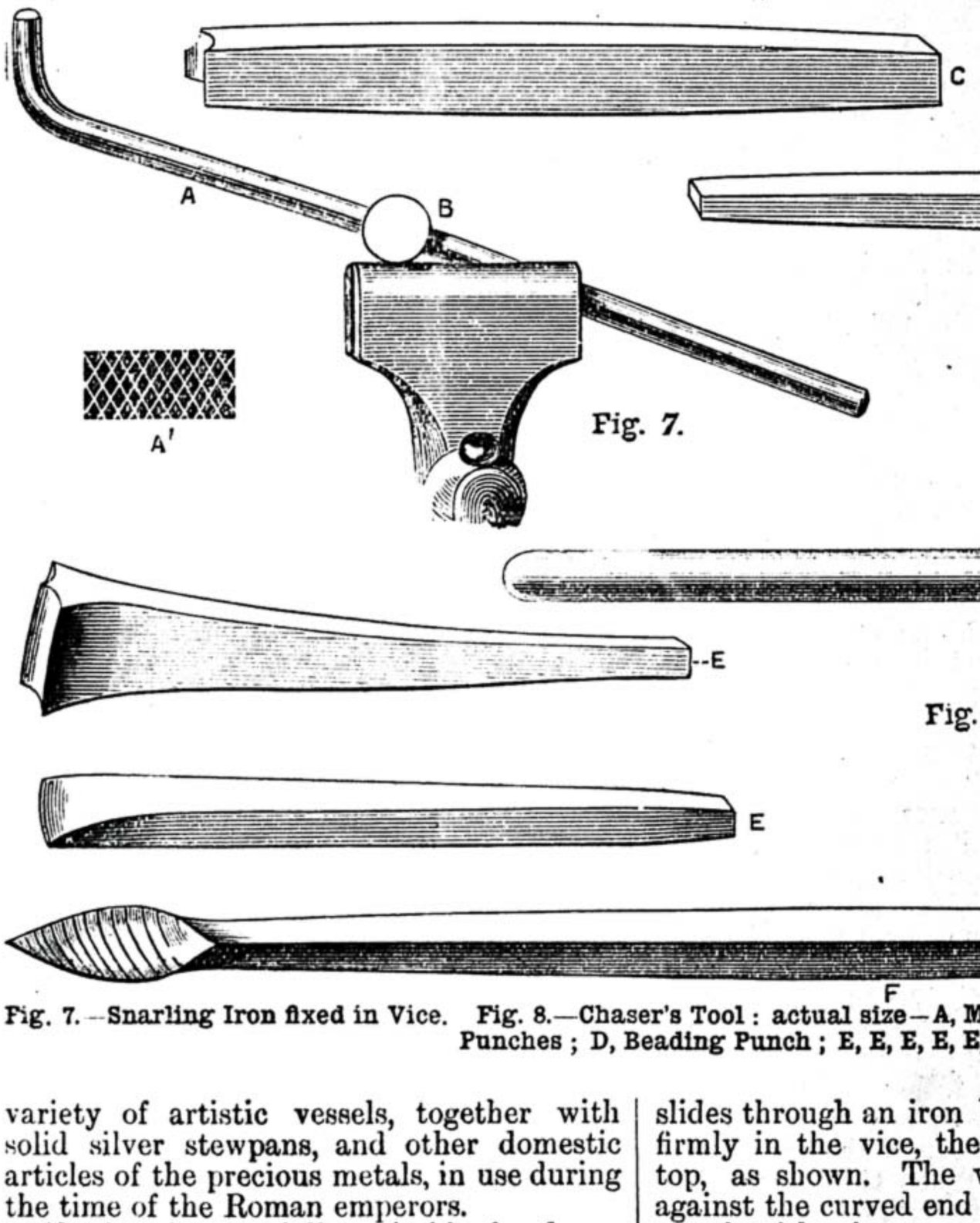

Fig. 7.

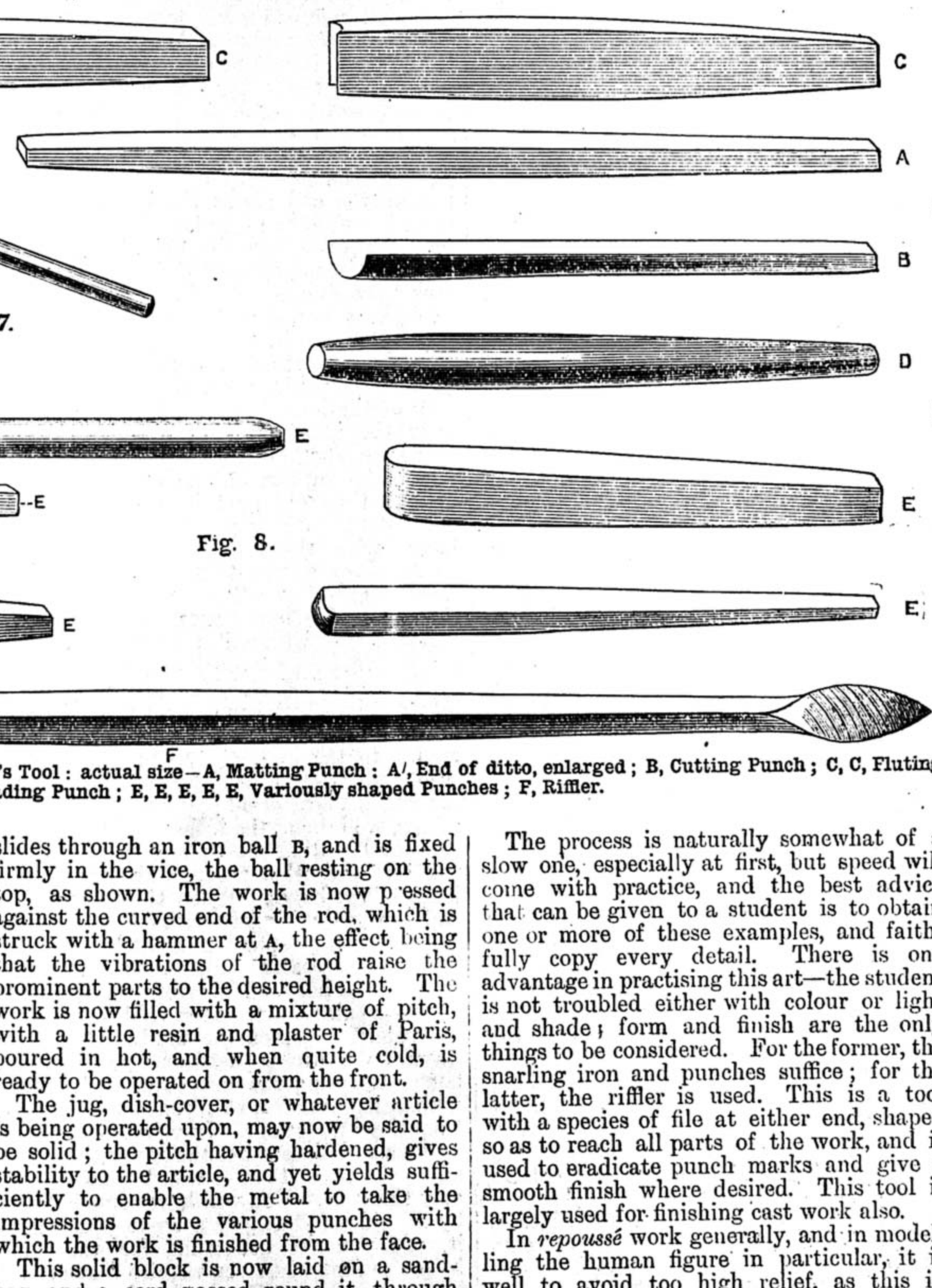

Fig. 8.

Fig. 7.—Snarling Iron fixed in Vice. Fig. 8.—Chaser's Tool: actual size—A, Matting Punch; A', End of ditto, enlarged; B, Cutting Punch; C, C, Fluting Punches; D, Beading Punch; E, E, E, E, E, Variously shaped Punches; F, Riffler.

A, the matting tool. This usually has a square or oblong face, cut with diagonal or other lines, and is used for the groundwork; it gives the matted or dead white ground, which contrasts so effectively with the fluted or other polished portions of the work; it is made in a variety of patterns, coarse and fine, to suit the style of work required.

B is called the cutting punch, and in its variety of shapes is used to indent the many outlines of the work.

C, C, are variously shaped fluting punches.

D, one of the many beading punches required — most useful tools, beads being largely used in chased work.

E, E, shaped punches. Several of these are required. The student, when he has the example before him, will soon see what particular effect has to be produced, and will procure the punch which makes the corresponding mark on the metal.

The process is naturally somewhat of a slow one, especially at first, but speed will come with practice, and the best advice that can be given to a student is to obtain one or more of these examples, and faithfully copy every detail. There is one advantage in practising this art—the student is not troubled either with colour or light and shade; form and finish are the only things to be considered. For the former, the snarling iron and punches suffice; for the latter, the riffler is used. This is a tool with a species of file at either end, shaped so as to reach all parts of the work, and is used to eradicate punch marks and give a smooth finish where desired. This tool is largely used for finishing cast work also.

In *repoussé* work generally, and in modelling the human figure in particular, it is well to avoid too high relief, as this in general gives vulgarity to the work. The figure of Minerva in the Hildesheim patera errs somewhat in this respect. In the works of the greatest masters, this is carefully avoided: roundness and fulness are given to the limbs without the metal being forced

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up to an undue height. Bas-relief—low relief—is more suited to *repoussé* work than alto-relievo—high relief, such as we usually see in ivory carvings. The mask or face will require very careful attention, as well as the hands and feet; these are important points. Drapery should be cut sharp and clear, falling in graceful folds, showing the contour of the body beneath. There should be no indefinite outlines; the figures should be crisp and sharp, in contradistinction to painting, where this effect is avoided. A study of the best works, however, do more for the student than any written directions, and although in themselves they are very costly, fortunately, by the electrotype process, copies can be had which answer every purpose. A word as to flat chasing. This, as the term implies, is the decoration of flat surfaces without the use of the snarling iron. The article to be operated on is filled with pitch, or if a tray or salver, as is often the case, embedded on the same, and chased in the usual manner, but, of course, without any embossing or *repoussé* work.

THE ART AND PRACTICE OF SCENE PAINTING.

BY WILLIAM CORBOULD.

Necessary Tools and Appliances.

Introduction.—The principal object that I have in view in writing this and the papers which follow it is to give the readers of Work, if they care to have it, some knowledge of a very agreeable and pleasing subject—"The Art and Practice of Scene Painting." Assuming that the reader has a fair knowledge of freehand drawing and perspective, and a taste for colouring, he may attain, after a little practice and carefully following out the instructions to be given, no small proficiency in this attractive work. I shall treat the subject in regular stages, commencing with the materials to be used—which may be purchased at small cost—and proceeding by taking a simple scene, and describing the method of painting it from the first step to its finish, thus giving some practical hints on the subject, the following of which, I trust, may lead to pleasant and profitable employment, either for leisure hours, or even as a means of adding to one's income, if not of making a living by the prosecution of the art.

Brushes.—The first thing to be taken into consideration is the brushes that the scene painter will find absolutely necessary, their several kinds and sizes, and how to choose them. Fortunately, from a pecuniary point of view, not many will be required to begin with, but they must be good. Brushes also require care, both in using them and in washing them clean; and, more than this, when work is done for the day, the hair of each brush should be placed straight in the proper form before putting them away. One or two large brushes will be needed for priming and laying-in purposes—painters' stock brushes, as they are called, will answer the purpose—such as is shown in Fig. 1. Then it is desirable to have a one-knot distemper or oval brush—as shown in Fig. 2—and about six sash tools of different sizes. Of these, Fig. 3 represents a string-bound sash tool, to be got in different sizes. Fig. 4 is a long-hair sash tool; these will be found useful as foliage brushes. Figs. 5 and 6 are quilled under the binding, Fig. 5 being a long-haired and Fig. 6 a short-haired tool. Fig. 7 is a flat hog-hair tool in tin, with polished handle; these, it may be said, can be obtained round or flat in different sizes. Fig. 8 is a flat, bevelled, hog-hair lining brush. I shall explain the way in which the various brushes are used further on.

Palette Board.—This is an important article, and I must tell you how to make it, and prepare it for work.

First, get about 20 ft. of ¾ in. floor-board: cut four pieces 2 ft. 6 in. long, and five pieces 2 ft. long; take the five short pieces, and lay them as in Fig. 10. Now place the four longer pieces lengthways on the top of the five short pieces, as in Fig. 11; screw them together with 1¼ in. screws. It is better to screw the boards together by turning the whole over, and screwing from the bottom. Of course, the rough sides of the boards would be put together inside, leaving the palette board smooth at top and bottom, and the best of the wood should be used for the top pieces. Then take another piece of board 2 ft. 4½ in. long, and plane up the rough side, and saw it down the middle, as in Fig. 12. Next take another piece 3 ft. 8 in. long: plane it, and saw it down the middle in the same way; then cut the two lengths in half, and you will have four pieces 1 ft. 10 in. long. Take the two longest pieces and fix them on the back part of the board, leaving ¾ in. at each end, so that when you put on the end pieces the box will be the same length as the board. Take two of the four pieces you have 1 ft. 10 in. long. and cut 4 in. off one end of each of them. You will now have two pieces 1 ft. 10 in. long, and two pieces 1 ft. 6 in. long; place the long piece as shown by the dotted line A in Fig. 13, and the short piece as shown by the other line, B. The longest pieces close in the two ends of the long box, and the short pieces form the inner sides of the short boxes. Plane up another piece, and cut down the middle, as in Fig. 12, and cut up the two lengths thus obtained into square pieces about 3 in. each way. Divide the larger boxes with these pieces, thus forming smaller boxes about 3 in. square. Two pieces 4½ in. long will be required to close the end of the short boxes. Put the boxes together with wire nails; round off the two front corners, and the board will have the appearance of Fig. 9. Now give it a coat of oil priming, which you can get made for you at any oil and colour shop, should you be a novice in the matter. When this is dry, stop well with white-lead putty, and give the whole a coat of oil-paint of a light drab colour, well doing the inside of the boxes, to prevent the different colours from running one into the other through the crevices or joints of the boxes. When this coat is dry and hard, paint it again with a lighter colour—nearly white—putting a little gold-size into the last coat of paint, that it may dry quicker and hard. The several colours used in scene painting are then rubbed up with the palette knife on the marble slab, with water only, into a paste, and put into the boxes—covering the surface of each colour with a little water, as often as required, to keep them fit for use. In using any colour, take a small piece out of the box with palette knife, and place it on the board wherever you may think fit. You will have some hot size by the side of you—put a spare brush into it, one you are not using for the time being, so that when you require "medium" for your colours, lift the brush out of the pail, and let sufficient run off on to the colour. By this means the medium is kept clean; whereas, if the brush that you are using for the colour were dipped into the medium, the colour in the brush would discolour and spoil it. I may as well explain that the medium should be about half size and half water, and when making it hot for *use*, never let it boil.

Marble Slab.—This may be got from any marble mason who makes tops for washstands: the round piece taken out for the basin makes one of the best slabs you can have.

Palette Knife.—Get as large a palette knife as you can: they are made of the best steel, and have a particular shape of their own, as shown in Fig. 14.

Flogger.—This is an appliance used for dusting off the charcoal lines after they are of no more use, and are painted in with Vandyke brown. It is made by cutting strips of cloth or canvas about 2 ft. long and 2 in. wide. These strips must be fastened strongly to a piece of wood about 2 ft. long, after the fashion of a cat-of-nine-tails, as shown in Fig. 15.

Compasses.—A pair of these, with one leg fitted with a tin tube to hold a piece of chalk or charcoal, the other leg to have a pin inserted so that the point will have a hold in the canvas, may be bought at any educational depôt. But I will tell you how to make a pair about 18 in. long. Take two pieces of clean wood, free from knots, 18 in. long and 1½ in. square; cut a mortice in one and a tenon in the other, as in Fig. 16, so that they may fit one in the other. Put in a screw, as at A; when the square parts are cut to the proper shape, as in Fig. 17, and put together, and the screw inserted, you have the tool as shown in Fig. 18.

Straightedge.—This is another tool which is absolutely indispensable, but easily made. Take a piece of wood about 5 ft. long, 2½ in. wide, and ¾ in. thick: plane it up nicely; bevel it on the two inner edges, about 1 in. from the centre, and bevel it so that the edge will be about ¼ in. thick, and finish off the edge by one shoot of the plane, so as to ensure a perfect straightedge. Now take a piece of wood about 2 in. square and 5 in. or 6 in. long; cut or plane two edges off, as shown in Fig. 19, the shape of the section or end being shown at A; screw this piece on the back of the straightedge, putting the narrow side on the back of the straightedge, and if you slightly round off the square edges at the top, it will form a good handle, as shown in Fig. 20. Fig. 21 shows section of the straightedge and handle, with the bevels, which are done to prevent the colour on the edge from touching the work.

Horizontal and Perpendicular Lines.—These and perspective lines are generally made by the aid of a piece of whipcord and a pear-shaped piece of lead, known technically as a "plumb-bob." Should you not have a lead bob, anything in the shape of a weight—say about half a pound—will do, fastened to the end of a line.

Spatulas.—Make three or four of these. They are merely pieces of wood for making and breaking up colours. A piece of wood, 15 in. long, 9 in. wide, and ¾ in. thick, will, if sawn down, make four. After the pieces are sawn out, cut and trim them up as shown in Fig. 22.

Zinc Pails.—The scene painter should provide himself with three or four small ones. One should be kept expressly for size, and a large one for straining purposes.

Straining Sieve.—This may be purchased, or you may make a very good substitute with four pieces of wood—say 12 in. long and 3 in. or 4 in. wide—nailed together to form a square frame, as shown in Fig. 23. Tack or tie with string a piece of coarse cloth or canvas round the box. After

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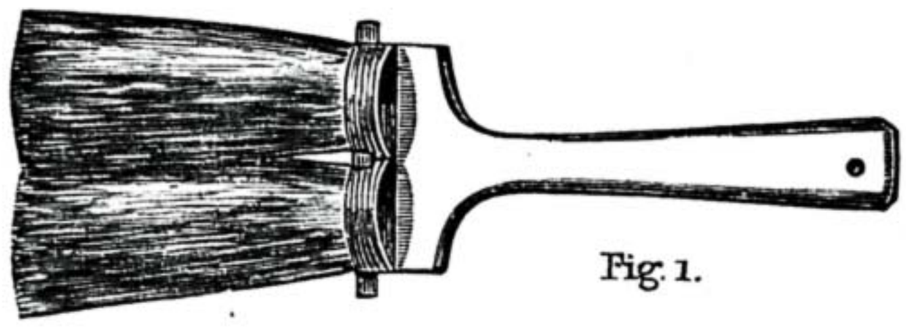


Fig. 1.

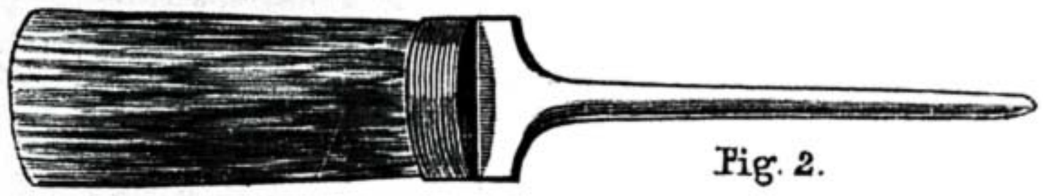


Fig. 2.

Fig. 4.

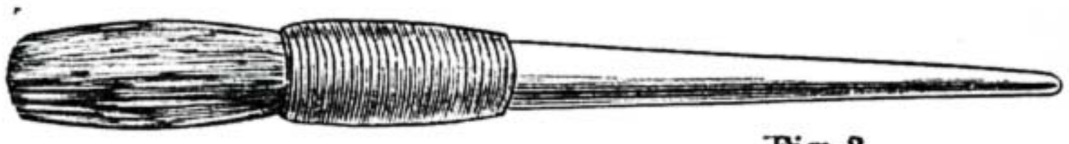


Fig. 3.

Fig. 6

Fig. 5.

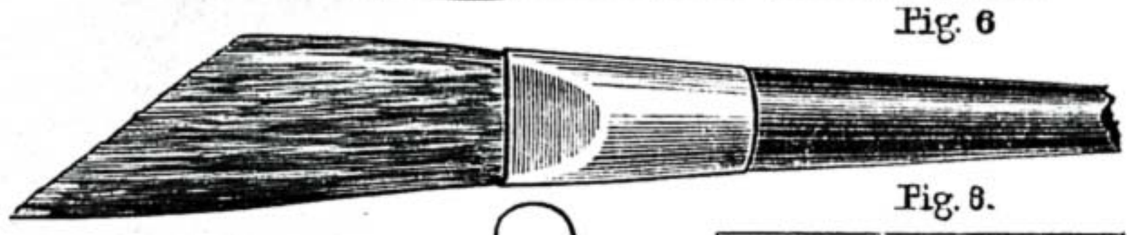


Fig. 8.

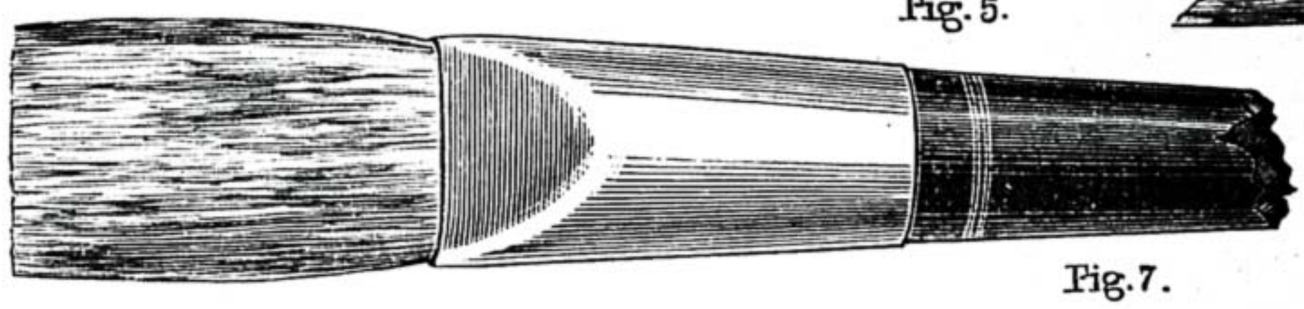


Fig. 7.

Fig. 15.

Fig 14.

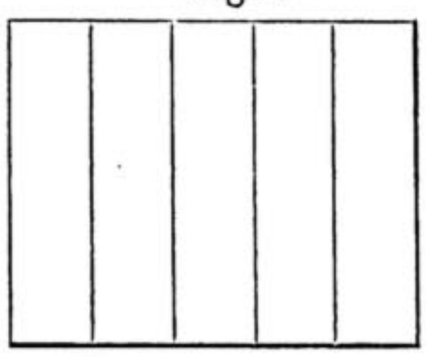


Fig. 10.

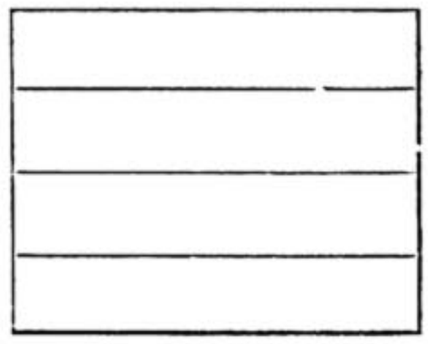


Fig. 11.

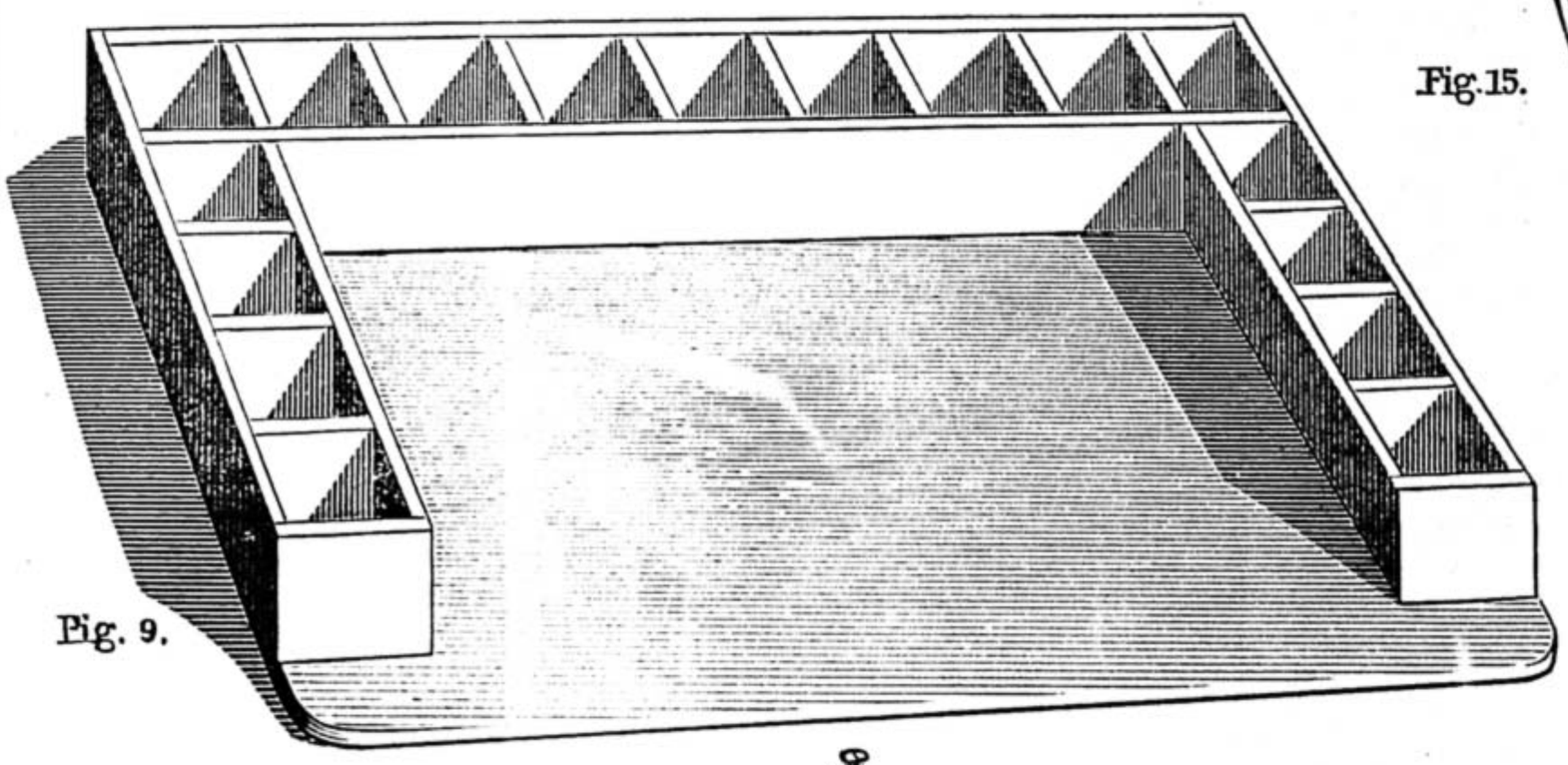


Fig. 9.

Fig. 12.

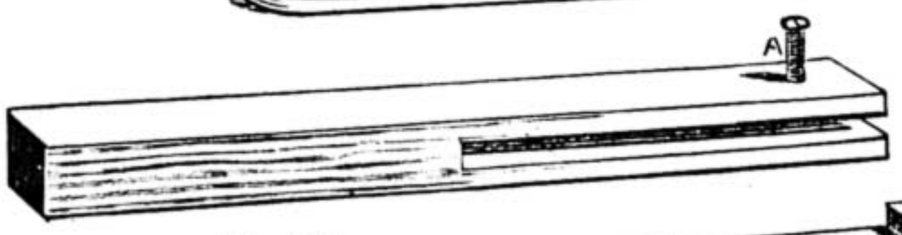
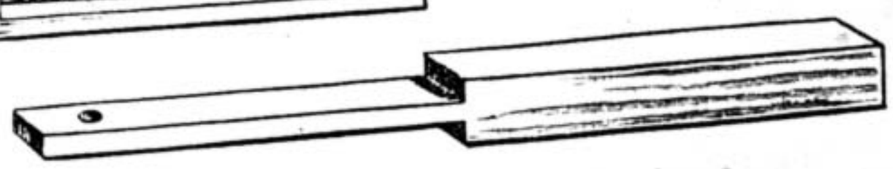


Fig. 16.



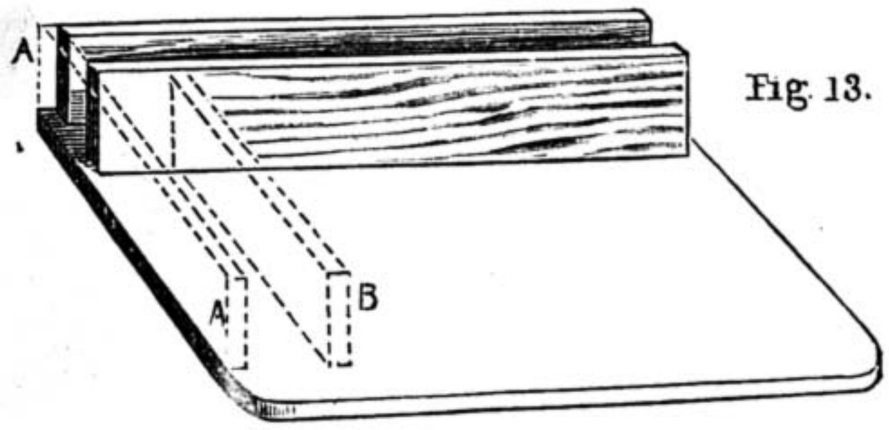


Fig. 13.

Fig. 17.

Fig. 18.

Fig. 22.

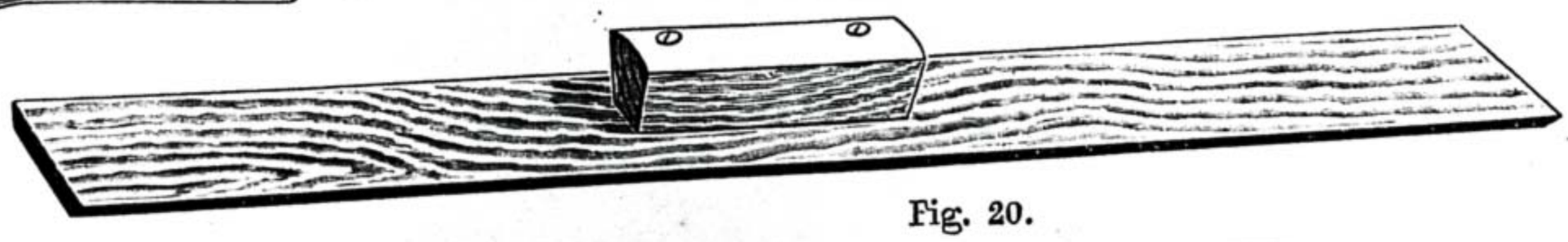


Fig. 20.

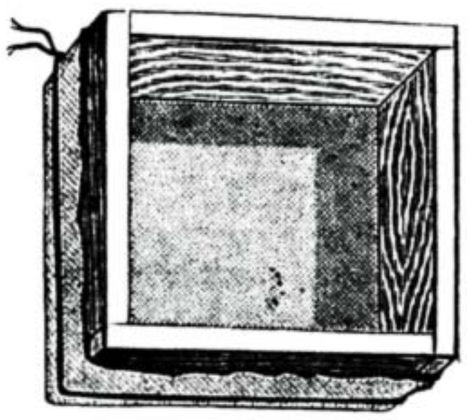


Fig. 23.

Fig. 19.

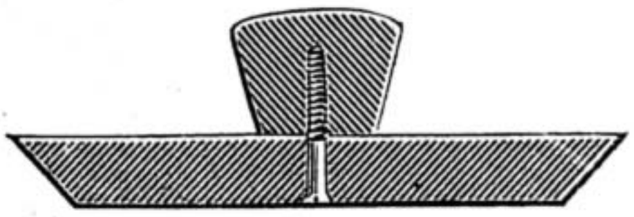


Fig. 21.

TOOLS AND APPLIANCES FOR SCENE PAINTING. Fig. 1.—Painter's Stock Brush. Fig. 2.—One-knot Distemper or Oval Brush. Fig. 3.—String-bound Sash Tool. Fig. 4.—Long-hair Sash Tool. Fig. 5.—Quilled Long-hair Tool. Fig. 6.—Quilled Short-hair Tool. Fig. 7.—Flat Hog-hair Tool. Fig. 8.—Flat, Bevelled, Hog-hair Lining Brush. Fig. 9.—Palette Board. Figs. 10, 11.—Disposition of Pieces to form Top and Bottom of Palette Board. Figs. 12, 13.—Mode of forming Boxes to contain Colours. Fig. 14.—Palette Knife. Fig. 15.—Flogger. Figs. 16, 17, 18.—Compasses. Fig. 19.—Handle of Straightedge—A, Section. Fig. 20.—Straightedge with Handle complete. Fig. 21.—Section of Straightedge and Handle. Fig. 22.—Spatula. Fig. 23.—Straining Sieve.

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straining any colour, wash the strainer clean. If you leave the colour to dry on, it would be more difficult to clean for another time. The canvas can be replaced when worn out. This is intended only for large quantities of colour, such as is used for priming or sky colour; but if care be taken to have the whiting clean, and the size perfectly melted—though on no account must it be permitted to boil—the trouble of straining may be saved. In making any colour such as blue-colour for sky, after soaking the whiting, pour off as much of the water as possible, and then put in some blue celestial or azure blue and emerald-green, and beat them up well together with a spatula before thinning with the size. This way of mixing colour, as it has been said, saves the trouble of straining materials.

Canvas: How to Choose and what to Use.—There is a fine flax linen canvas, 2 yds. wide, at about 1s. 1½d. per yard, which can be bought at any large linendraper's. This answers the purpose well, as it is free from dressing or any foreign substance detrimental to colours. Many amateurs use brown calico, which is very objectionable on account of the lime and other matter used in its manufacture, which has a tendency to destroy all colouring in a short time, no matter how well the work may be done.

Size.—This is the medium used for mixing colours and other uses in scene painting. It can be obtained at any oil and colour shop; but should you not be able to do so, try to get some parchment clippings, which must be well boiled. To do this, put the clippings into an iron saucepan, fill it with water, let it stand twenty-four hours till the pieces are well soaked through, then boil them for five or six hours, taking off the scum as it rises to the top. When it has melted to a liquid, take it from the fire, and strain it through a piece of canvas. If you are making a quantity to last for some time, you must add about three ounces of powdered alum, dissolved in boiling water, to every pail of size. If you cannot get parchment clippings, get some of the palest-coloured glue you can, break it up into pieces, and put it into cold water—best in a small pail—for twenty-four hours; when well soaked, place your small pail into a large one, and put as much water into the large pail as will not run into your small pail when boiling. When the glue is all well melted, you may add as much water in it as you think will leave it a soft jelly when cold. One thing more: whichever kind of size you use, in heating it for using do not let it boil again, for boiling spoils it. As soon as you see it is liquid take it off the fire.

Whiting.—The mixing and preparation of whiting, which is called "distempering," is a term applied to all colours mixed with water, with the addition of size or glue. The first thing to be done is the mixing for priming the canvas, when it is ready for that process. To make a good pail of priming, take about one dozen of whiting—that is, about five balls—break it up, and pour sufficient cold water on it to cover it. After about half an hour—when it will be well soaked—rub it well with the hands, or beat it with a spatula, until it becomes a nice smooth paste. When done, take some melted size, which should be hot, in readiness for use, and pour it into the whiting, lightly stirring it till both whiting and size are well mixed together. When this is cold it ought to be of the consistency of castor-oil. It would be as well, perhaps, before leaving it to cool, to strain it through a hair sieve or coarse piece of cloth or canvas.

Charcoal.—This you may purchase at any oil and colour shop, or, perhaps, of any artists' colourman; but should you not be able to do so, get some stout willow wood, cut it into pieces about 6 in. or 8 in. long, put them in the fire, burn them until there is no flame—the sticks assuming a dark red tint—then take them from the fire; when cold they will be fit for use. I mention the willow, because it is the best possible wood for this purpose.

MODEL ELECTRIC LIGHTS.

BY GEORGE EDWINSON BONNEY.

LIGHTING BY MEANS OF CURRENT FROM DYNAMO-ELECTRIC MACHINES—WHAT IS A DYNAMO-ELECTRIC MACHINE? — SIEMENS' DYNAMO-ELECTRIC MACHINE—THE FIELD MAGNETS—THE ARMATURE—THE COMMUTATOR AND BRUSHES—THE BRUSHES—WINDING THE ARMATURE.

Lighting by Means of Current from Dynamo-Electric Machines.—The area in which we can work to light up electric lamps with current derived from primary batteries is somewhat circumscribed by defects in this method of generating a powerful electric current. To get a sufficiently high E.M.F. to overcome the resistance in the lamps, *we must use a large number of cells* connected in series, and, to provide a large volume of current, *we must use large cells*, or the battery will soon run down. When a current of three ampères or more is required from a battery, the wear and tear is considerable; hence it is costly and inconvenient to lower the resistance of the lamp circuit (as by placing the lamps in parallel), since by so doing a greater demand for current is thrown on the battery, and as this extra current passes through the cells, their contents are heated, with the result that they are more quickly worn out. Then comes the costly, dirty, and laborious job of cleaning and recharging the cells, and this in itself is enough to make us wish for some better method of generating the current. For small model electric lights, such as night lights, occasional lights of low power, and those mentioned in my last paper, a small bi-celled chromic acid battery, or even a Fuller bichromate battery, will give every satisfaction. But when we wish to extend the area of lighting, we must have recourse to such generators of current as that of a dynamo-electric machine. With these machines, and ample power to drive them, the area is so much widened as to become practically unlimited. In this field we are only held back from large operations by a want of power to drive the machines. Given an abundance of power, supplied by any motor, and we can then make a machine capable of supplying sufficient current to light up a whole village.

What is a Dynamo-Electric Machine?—A dynamo-electric machine is a machine for converting dynamic energy into electric energy. Dynamic energy is shown when matter is set in motion by propulsion, as when the piston-rod of a steam-engine is propelled by the force of steam behind it, or that of the gas-engine by the ignited gas. We are all familiar with the methods adopted to convert mere propulsive motion (*i.e.*, thrust and pull motion) into circular motion by means of cranks and wheels, but all are not so familiar with the method adopted to convert this form of motion into that of intense vibration as represented by electricity. To do this, a special machine has been invented, and since its function is to convert energy from the dynamic to the electric form thereof, it is named a dynamo-electric machine.

Since the invention of the first dynamo in 1832, by Pixii, the machine has passed through many phases of evolution. It began under the name of a magneto-electric machine, and continued to bear this name whilst permanent steel magnets were employed in its construction. It was then as truly a dynamo as any one of its successors, since the permanent magnets only acted when moved by dynamic energy. They had no power in themselves to move themselves. Those of my readers who may wish to trace the evolutions of the machine from Pixii's invention to Ferranti's monster dynamos at Deptford, may do so in the pages of "Electricity in the Service of Man," now being issued in sixpenny monthly parts by Messrs. Cassell & Co., Limited. It is not in my province to give a history of the machine, but to show how those are made which are most suitable to the subject now under treatment. The machines now in general use by amateurs for electric lighting purposes may be arranged in classes named according to the types of armatures, or of field magnets used in their construction. In the first class we may place the Siemens machine, so called because in its construction we use the Siemens H armature in either its original solid form or built up of laminated iron plates. In the second class we may place the Grammé machine, so called because we use in its construction both the form of armature and the field magnets invented by M. Grammé. In the third class we may place the Manchester machine, so called because we use in its construction field magnets of the Manchester type. In the fourth class we place the Simplex machine, so called because it has only one simple core to receive the wire intended for the field magnet. All these machines work on the magnetic induction principle—that is to say, their field magnets are not made up of pieces of steel permanently magnetised, but are constructed of soft iron, containing just a trace of residual magnetism, which is induced (by dynamic energy imparted to the armature) to exert its influence on the armature coils, and create in them a current of electricity. This current is then sent around the field magnet coils, with the result that a stronger magnetism is induced in the cores of the field magnets. Being thus strengthened, they induce a stronger current in the armature coils, and thus the full electric power of the machine is worked up. We will take each of the machines in order, and briefly give a few details concerning their construction.

Siemens' Dynamo-Electric Machine.—In 1857, Dr. Werner Siemens invented the simple form of armature now known as the Siemens H girder, or cylindrical armature, so called because a cross-section of it resembles the section of an H iron girder with cylindrical sides. This is shown in the illustration (Fig. 14). As this form of armature, together with the field magnets, are easily made, wound, and set up, it has become a general favourite with amateurs. The form of the machine in general use is shown in section at Fig. 15, whilst Figs. 14 to 33 show in detail the forms of its several parts. The diagram Fig. 15 shows the position of the parts composing the skeleton frame, or carcase, of the machine; A being the armature; M, M, the field magnets; C, C, the field magnet cores; and Y, the yoke to which the field magnet cores are bolted or attached by screwed studs.

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The Field Magnets.—These are made to the form shown at Fig. 16, or in that shown at Fig. 17, in various sizes, to suit the other parts of the required machine, as shown in the annexed table. They are made in malleable cast iron, and are sent out annealed soft, ready for use, by men who make the trade in these things a speciality. A full set of castings for a Siemens pattern machine of the smallest size can be obtained for five shillings, and this will make up a 5 c.p. machine. The castings for a machine of 120 c.p. will cost about thirty-five shillings. It will therefore be seen at once that it will not pay the amateur to make his own patterns and get the castings made to them. It must be understood, however, that all castings received from vendors of those things are in the rough as they come from the foundry, unless otherwise ordered, and an additional price paid for the labour of shaping and fitting them ready for winding on the wire. I will suppose, however, that the castings are received in the rough, and we will now set about preparing the field magnet castings. These should be soft enough to allow a file to "bite" the iron easily; for if hard enough to resist the action of the file they are too hard for this purpose, and are not properly annealed. The first job will be to clean them and true them up—that is, remove any rough ridges left on the edges, or nodules of iron, from the armature channel. This may be done in a lathe or by means of a half-round coarse file. The two castings for the field magnets must be a pair, and when stood side by side on a level bench, the armature tunnel between them should be of regular form throughout, the cores of one height and size, and be parallel to each other when upright. If slight irregularities appear on the sides of the tunnel, take them off with the rounded face of the file. The corners of the cores should also be rounded and filed smooth, to prevent abrasion of the wire covering whilst the wires are wound on. If the castings are shaped as shown at Figs. 15 and 16, holes must be drilled and tapped at *a*, *b*, Fig. 16, to receive screwed studs to hold the yoke in its place on the F.M. cores. Small holes ($\frac{1}{4}$ in.) must also be bored in the lugs at *c*, *d*, *e*, *f*, to receive screwed studs or small bolts securing the armature bearings to the lugs. Two $\frac{1}{2}$ in. holes must also be drilled in the feet of the castings at *g*, *h*, to receive short coach screws used for bolting the castings to their wood base. The yoke to connect the F.M.'s, shown at Fig. 15, is merely a rectangular piece of iron supplied for the purpose with the castings, and this must be fitted truly on the top of the F.M. cores, holding them in the position they must occupy when the machine is at work. In the small Siemens machines supplied by Mr. Jones, of Lambeth, this yoke is dispensed with, as the top of one of the castings projects sufficiently to bridge over the space between the two, and thus form the yoke. In the castings supplied by Mr. Bottone, also, the two projections have turned-up flanges, as shown at Fig. 17, and these are bolted together to form a yoke. It must be distinctly understood, however, that the two F.M.'s must be connected in this or in a similar way by an iron bridge, so as to form a horse-shoe magnet, between the poles of which the armature is made to revolve.

The Armature.—The solid H girder form of armature used in these machines is shown at Fig. 18. It is a casting of soft well-annealed iron, and is supplied with the other castings for the machine. It is most important that this also should be annealed soft. The channel for the wire should be true and smooth, and the ends of the web (marked w on Fig. 14) be rounded and smoothed to prevent abrasion of the wire covering. The rounded faces of the cheeks must also be free from nodules, and they must also be true from end to end. The ends must be filed or turned true to form faces for the spindle holders shown at Figs. 19 to 21. These are secured to the ends of the armature by screwed studs, and holes must be drilled and tapped to receive them, as shown at *a*, *b*, *c*, *d* (Fig. 14). In the larger sizes of machine, the armature is built up of soft iron laminated plates, or punchings of sheet-iron shaped as shown at Fig. 22. These are also prepared and sold by the dozen and by the gross, by men who make it their business to produce them, the prices ranging from 3s. 6d. to 10s. per gross, according to size.

The armature is built up by stringing these punchings on a steel spindle, as shown at Fig. 23, after which they are placed in their proper position, and secured there by running nuts threaded on the steel spindle at each end, so as to pinch the whole series of plates between them. The result is to form a channel for the wire and faces for the cheeks of the armature similar to that of the solid H girder form. This laminated form of armature has been invented to lessen as much as possible the tendency of the H girder armature to heat, and form cross currents in itself whilst working. The laminations are divided from each other by narrow air spaces, and these help to keep the armature cool. The spindle of this form is made long enough to pass through the end bearings or journals in which they run to drive the armature. The solid form of armature requires two spindle holders bolted or screwed to the armature. These holders are made of brass, either cast with a projecting boss, or made up of a disc of brass with a piece of brass tube fitted in the centre to give holding power on the spindles. The spindles should be of steel, turned true and smooth, and fitted tightly in their respective holders. The projecting bosses of these spindle holders running against the bearings, prevent end shake of the armature; but when a laminated armature is employed, the ends of the spindle must be turned down a little to form a shoulder for this purpose.

The bearings for the smaller sizes of machines, shown at Fig. 17, are cast in gunmetal to the form shown at Fig. 25, or cut out of sheet brass to the form shown at Fig. 29, and are secured to the ends of the F.M.'s by long bolts resting in the slots shown in the lugs. They then clamp the front and back bearings together, as the bolts run the whole length of the sides of the machine. The bearings for the other forms are similarly made, but they are secured to the lugs of the F.M.'s by screwed studs, or by small bolts passing through holes drilled in the lugs. Whichever form of bearing is employed, or however it may be secured to the machine, we must be sure to have the holes exactly coincident with the centre of the armature tunnel, so that the cheeks of the armature may not run nearer to one side than the other. They must also be fixed, to ensure the armature being hung in the centre, between the opening at the top and the space at the bottom of the tunnel. This being secured, we may now bolt the F.M.'s together, put on the bearings, and test the fit of the armature in its channel. It should be so centred as to leave just the space of from $\frac{1}{16}$ to $\frac{1}{20}$ of an inch between the *cheeks* of the armature and the sides of the tunnel, or just the thickness of a piece of stout brown paper. If the space is less than this, the cheeks may strike the sides of the tunnel as the armature revolves, and so render the machine non-effective. If more space than this is allowed, part of the power will be lost, because the armature will be removed from close proximity to the magnetised poles. If there appears to be any danger of touching the sides at any particular part, mark the place, and ease it with a file. A very effective way to test the fit of the armature is to paste a piece of paper neatly all over it, and then revolve it in the tunnel. On taking it out carefully, the abrasions on the paper will mark the prominent parts, and these may then be eased.

The Commutator and Brushes. — As this form of armature will be wound with only one coil of wire, the commutator will be what is known as a "two part commutator"—that is, one divided into two sections, one section for each end of the wire coil. These sections must be insulated from each other—that is, they must be divided by a substance practically incapable of conducting electricity—and must also be insulated from the rest of the machine, for if the electric current generated in the armature is allowed to traverse the armature coil only, there will not be any current available to do work outside the machine. The cheapest and handiest insulating substance available is boxwood well soaked in melted paraffin. Ebonite, or vulcanised fibre, will also serve the purpose, but are more costly. In the first place, therefore, we get a chunk of boxwood, out of which can be turned a wheel or pulley $1\frac{1}{4}$ in. in diameter and 1 in. across the face. The smallest sized machines take a commutator $\frac{7}{8}$ in. in diameter. Turn this up true, and bore a hole exactly in the centre to tightly fit one of the spindles when driven on. Then get a piece of brass tube with a diameter to exactly fit the boxwood boss, cut off a one inch length, smooth the interior of this brass ring, and force it tightly on the boxwood. If now this brass-bound boxwood boss were forced on the spindle as shown at Fig. 21, it might work loose in course of time, so to prevent it from slipping around, we turn down the hub of the spindle holder enough to get a good face for the boxwood boss to fit against, then bore two $\frac{1}{8}$ in. holes in the holder, and fit therein two short brass pins. When we have determined how the commutator shall go on the spindle, two shallow holes may be bored in the inside face of the boxwood pulley to exactly fit those pins, and so keep the pulley from slipping. The ring of brass must now be divided, and upon the way this is done will depend—all other parts being right—the proper working of the machine. If divided into two equal sections, by cutting straight across the tube, the current from the armature would be interrupted abruptly, and sparks would be caused, which would soon burn away the brass ring and also the brushes. The division must therefore be made obliquely or diagonally across the ring. But here, again, we must guard against making the division as shown at Fig. 27 (A), for this would be too oblique, and the interruptions would, in consequence, not take place at the proper time. To obtain the proper direction for this division, turn the boss on one end and draw a mark across the centre (as to find its diameter); $\frac{1}{8}$ in. on each side this line draw two other lines. Now turn the boss on its end, and scribe two fine lines across the brass on one side exactly coincident with the two lines

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on the end. Turn the boss over, and scribe two similar marks across the other side. Now scribe a mark diagonally across the space between these two lines on both sides, from the right-hand end of the top line to the left-hand end of the bottom line. Next, drill and countersink two small holes on each side of the line to receive two very small brass screws, as shown at Fig. 27 (B), and put in the screws, driving them well home. When this has been done, the ring may be divided by cutting it through to the boxwood on both sides along the diagonal lines. A hack saw will be found to be the best tool for this purpose; failing this, a fret saw may be used; but the division should be widened a little, and cleaned out well with a thin file, or it is apt to get choked and bridged with fine particles of metal worn off from the brushes. The holes for the fixing pins may now be bored, and the commutator fixed in its place on the spindle, having determined that the dividing line of the commutator ring shall be on the side of the coil nearest the left-hand cheek of the armature. Two small holes may be now drilled through the spindle holder (as shown at A, B, Fig. 19) for the ends of the armature coil to come through, and be securely fastened to the commutator ring.

The Brushes.—These are long thin pieces of springy brass, copper, or phosphor bronze, fixed to brush blocks insulated from the rest of the machine on each side of the commutator. Their duty is to pick up the impulses of the interrupted armature current from off the commutator sections, and convey those impulses to the field magnet coils and to the outer circuit. In the machines of some makers they are attached to boxwood blocks fixed to the bearings of the armature spindle (as shown at Fig. 29); in other machines they are attached to brass pillars (shown at Fig. 34) screwed into the wooden base of the machine on each side of the commutator. I must express myself in favour of wooden blocks, as shown at Fig. 29, with an adjustable brush holder attached to each block. When the brushes are fixed, as they generally are in small machines, their adjustment becomes a tedious task. The brush holder need only be a small brass bracket with a set-screw, as shown at Fig. 30. The brushes can then be slipped to and fro, and adjusted at any angle required, by placing wedges of brass above or below the back ends of the brushes. A very good material for the brushes of small machines is fine wire gauze cut into strips, and soldered (two or three thicknesses) to the ends of stout brass springs to ensure proper pressure on the commutator. I have shown three forms of brushes in general use at Figs. 31, 32, 33. That shown at Fig. 31 is merely a piece of thin spring brass, shaped as shown, and fixed to a pillar brush holder (Fig. 34). This is an objectionable form, as it is often getting out of order by wear, and cannot be easily replaced or adjusted. Fig. 32 is an improvement on the form shown at Fig. 31. It is composed of thin sheet brass, or hard hammered copper cut to the form shown, with one end (to the length of 2 or 2½ in.) slit into fingers, and a slot cut at the other end to facilitate adjustment. The fingers soon wear away, and must then be replaced. I am indebted to Mr. S. Bottone, of Carshalton, for the idea shown at Fig. 33. It consists of a piece of hard spring brass, to one end of which is soldered a pad of copper wire gauze. This bears on the commutator, and is kept in contact with it by the strip of spring brass to which it is soldered, the strip being curved (as shown at Fig. 29) for this purpose. This pad is most effective as a brush; it does not cut away the commutator like spring brass and copper, and it is easily adjusted or replaced if fixed in a brush block with clamp, as shown at Fig. 30.

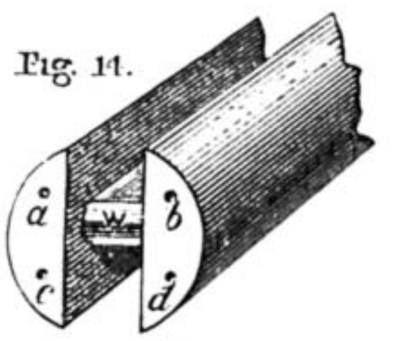


Fig. 14.

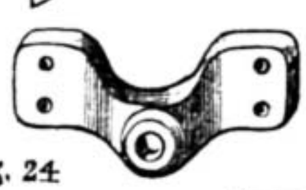


Fig. 24

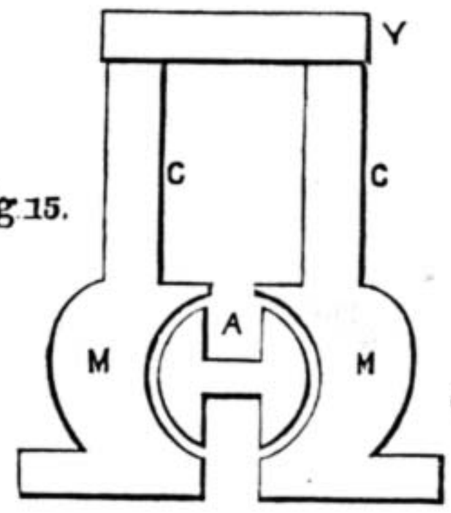


Fig. 15.

Fig. 26.

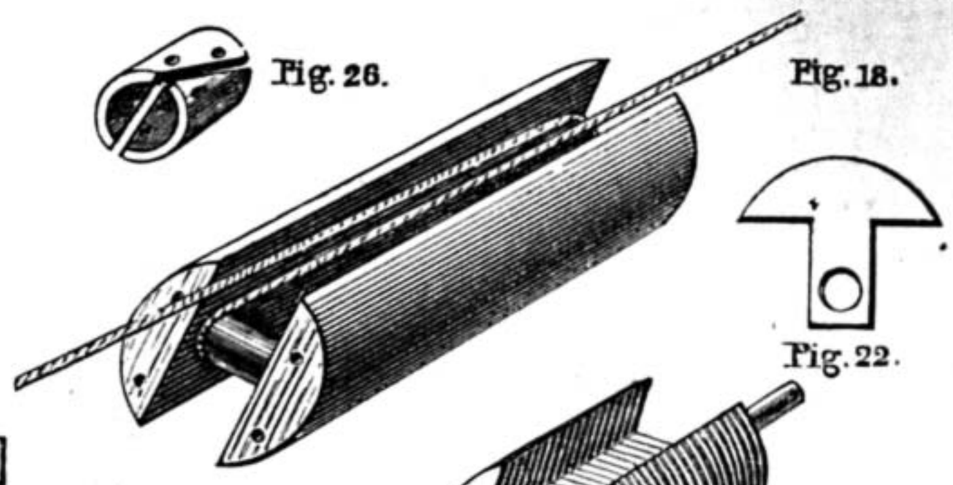
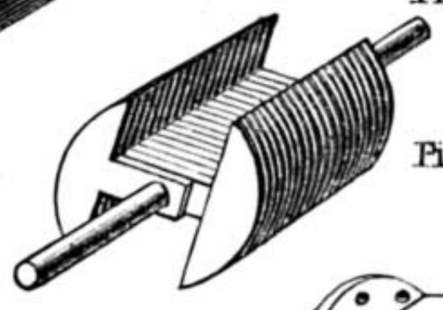


Fig. 18.

Fig. 22.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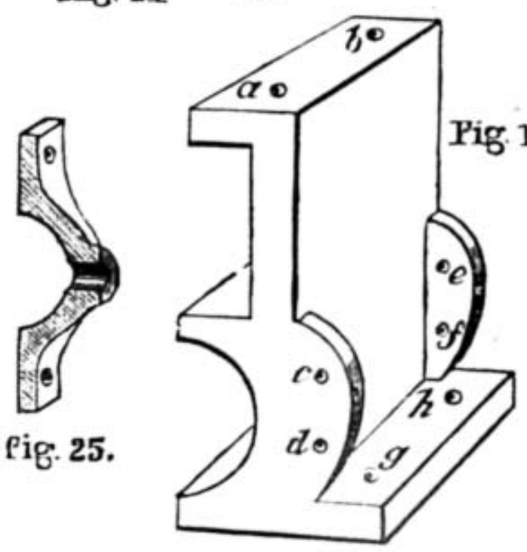

Fig. 16.

Fig. 25.

Fig. 19

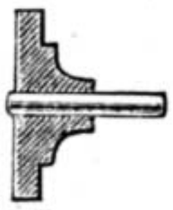
Fig. 20.

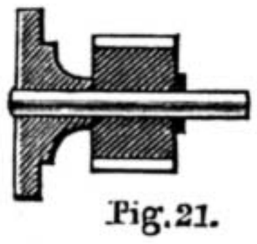
Fig. 21.

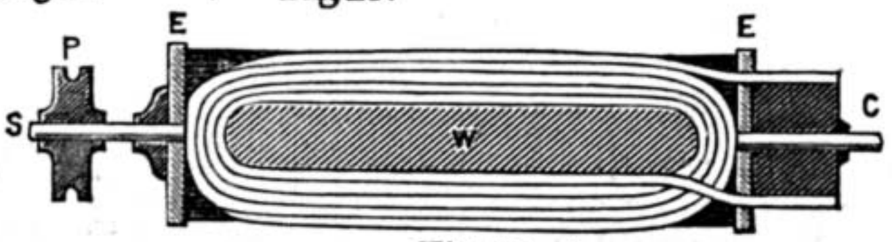

Fig. 28.

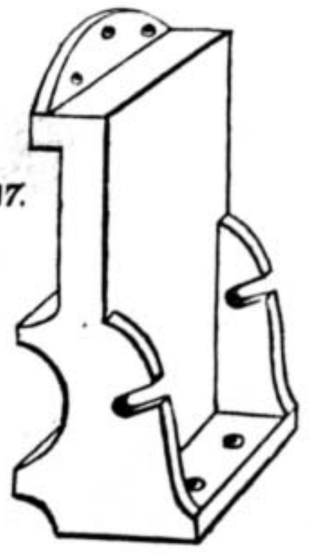
Fig. 17.

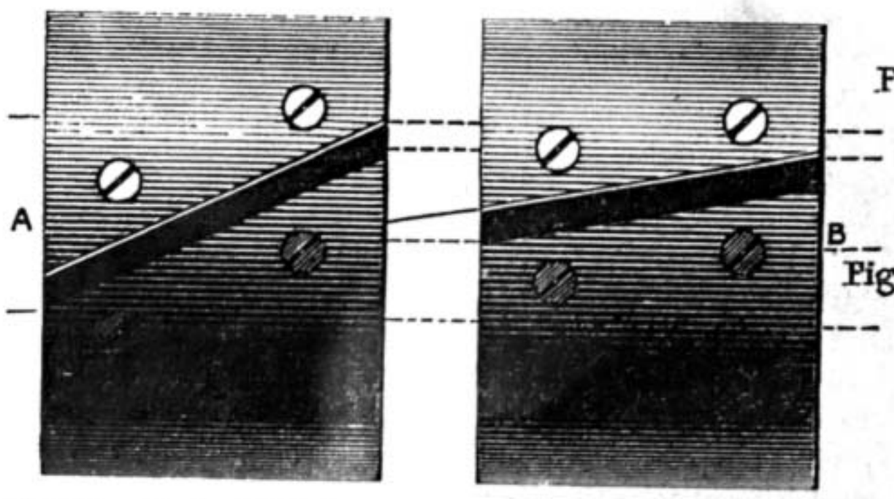

Fig. 27.

Fig. 29.

Fig. 30.

Fig. 34.

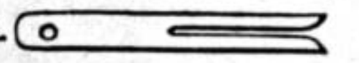
Fig. 31.

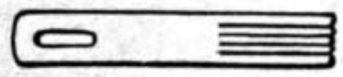
Fig. 32.

Fig. 33

Fig. 14.—End of Siemens H Girder Armature—W, Web of Armature; *a*, *b*, *c*, *d*, Position of Holes for Studs. Fig. 15.—Diagram of Siemens Machine—A, Armature; C, C, Magnet Cores; M, M, Magnet Cheeks; Y, Yoke. Figs. 16, 17.—Forms of Field Magnets. Fig. 18.—Solid H Girder Armature, showing how to commence winding Wire. Fig. 19.—Spindle Holder: end view. Fig. 20.—Section of Spindle Holder. Fig. 21.—Section of Spindle Holder and Commutator. Fig. 22.—Laminated Iron Punching for Armature. Fig. 23.—Iron Laminations strung on Steel Spindle to form Armature. Figs. 24, 25.—Bearings for Armature: end view and section. Fig. 26.—Brass Ferrule for Commutator. Fig. 27.—Commutator: full size, showing how to divide Brass Ferrule and fasten Ends—A, Division too oblique; B, Ferrule rightly divided. Fig. 28.—Section of Complete Armature—P, Driving Pulley; S, S', Spindles; C, Commutator; E, E, Holders; W, Web. Fig. 29.—End of Commutator, showing Position of Brushes. Fig. 30.—Clamp to hold Brushes on Brush Block. Figs. 31, 32, 33.—Some Forms of Commutator Brushes. Fig. 34.—Pillar Brush Holder.

TABLE OF MODEL DYNAMOS. SIEMENS' PATTERN.

No.	Size of Cores of F.M.'s	Size and Details of Armature.		Wire on F.M.'s.	Wire on Armature.	Power Developed.			Speed in Revs. per Minute.
	Inches.	Length.	Diam.	All connected in shunt.		Amps.	Volts.	C.P.	
0	4"×1¼"×⅜"	1¼"×⅛".	Solid.	12 oz. No. 24, s.c.	1½ oz. No. 24, s.c.	2	15	5	3,000
1	4×3×½	3½×1½	Laminated.	4 lbs. No. 22, d.c.c.	5 oz. No. 22, d.c.c.	2	25	10	3,000
2	5×4×⅝	4×1¾		4½ lbs. No. 22, d.c.c.	10 oz. No. 20, d.c.c.	4	45	20	2,500
3	6×4×¾	4×2¼		8 lbs. No. 22, d.c.c.	1 lb. No. 18, d.c.c.	5 to 6	60	50	2,000
4	10×8×1	6×4½		14 lbs. No. 22, d.c.c.	5 lbs. No. 14, d.c.c.	6 to 8	75	120	1,800

In the above Table, "s.c." means silk covered, and "d.c.c." means double cotton-covered copper wire. The candle-power—"c.p."—given is that of incandescent lamps only, and the machines are designed for this class of lamps.

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Winding the Armature.—Before winding the armature, see that the channel is free from lumps, and the ends of the web smooth. Then cut a strip of silk long enough and large enough to envelop the web. Coat this with some good shellac varnish, lay on the silk evenly to form a bed for the wire, and varnish the silk and the channel. When the varnish is dry, proceed to wind on the wire. This will be all the better for the purpose in hand if it has been previously soaked in hot melted paraffin. Commence winding as shown at Fig. 18, lay each coil side by side, as a reel of cotton is wound, and wind layer on layer, forward and backward, close and tight, until the wire set apart for this purpose has been all wound on. Then bring the two free ends to one end of the armature, put on the spindle holder (Fig. 19), bring the ends through the ivory-bushed holes made in this holder for this purpose, put on the commutator, and solder the two ends of the coil to the two sections of the commutator. Then put on the other spindle holder, and the armature is complete. The wire coil must not stand above the cheeks of the armature. If a fugitive layer stands up above the others, and threatens to knock against the sides of the F.M. tunnel whilst being revolved, it must be gently pressed into its place with a piece of smooth wood.

I have again outrun the space at my command, so must defer further particulars on winding the laminated armature and the field magnets to my next article. I therefore give at foot of page 644 a table of measurements suitable to the construction of a few machines of this class. The castings and other necessaries for them are sold by Mr. S. R. Bottone, Carshalton, Surrey; and castings for similar machines can be had from Mr. H. Jones, High Street, Lambeth, S.E.

A COMBINATION CENTRING-DISC AND GAUGE.

BY OPIFEX.

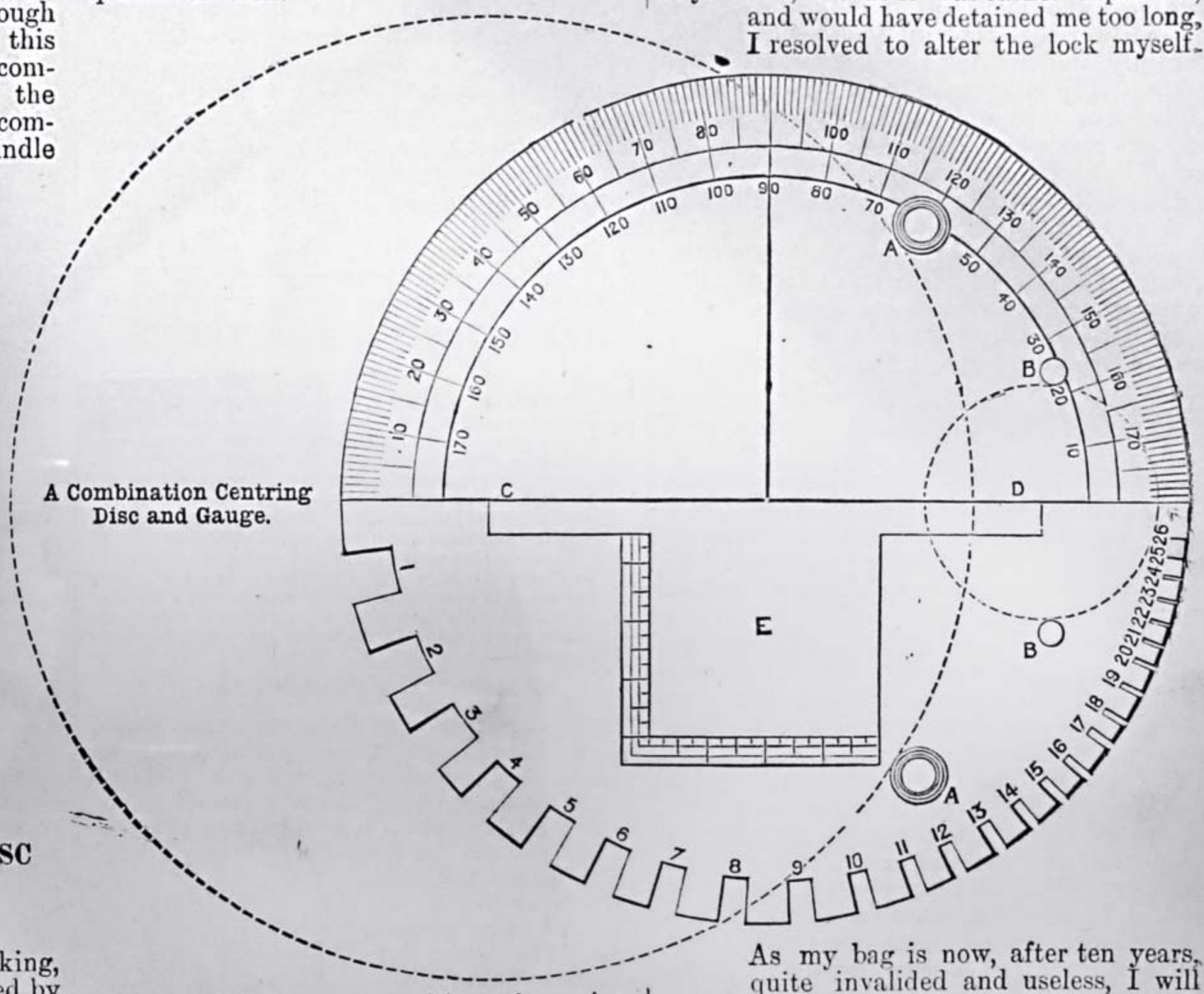
COMBINATION tools are, generally speaking, unsatisfactory, no good end being gained by the endeavour to make one article perform various functions, and the experience of all workmen, I think, goes to prove that no tool of this description does its work as well as an ordinary one. There are, however, exceptions to this, as to every other rule, and it is often a great convenience to possess an appliance that will serve more purposes than one; and this is true with regard to tools for measuring and marking work, especially metal work.

The centring-disc and gauge here illustrated has nothing novel to recommend it, but will be found useful to turners and metal workers generally. The principle of the centre square is the same as found in many workshops, but it is usually in the form of a small T-square, having a small pin projecting from the ends of the cross-piece, while one edge of the shaft forms a line at right angles with one joining the centres of the pins.

In the case of the disc before us, there are two pairs of pins, A, A, and B, B, to suit comparatively large and small cylinders, and the edge C D of the open slit serves for marking the lines by which the centre of a cylinder is obtained.

As represented by the two circles in dotted lines, any cylinder from 4 in. to 1 in. diameter may be centred by means of this tool, and, if the pins A, A, were placed further apart, and the pins B, B, nearer to each other upon the circle which passes through their centres, cylinders considerably larger and smaller could be centred.

The open space E is an inch square, and is graduated to $\frac{1}{16}$ in. upon two sides. This will be found useful for measuring and matching bolts or square iron, etc., of any scantling up to an inch square. A wire, or plate gauge, as shown on the lower semi-circumference of the disc, also forms a most useful adjunct in this combination, whilst the protractor formed by the upper semi-circumference and centre line of the disc speaks for itself.



A Combination Centring Disc and Gauge.

I need hardly say that this tool requires most careful and accurate work, or that it is useless for anyone who does not possess a good lathe to attempt to make it; considerable skill in the use of the file and the graver is also essential, but to any person possessing these, the subject before us furnishes a good opportunity for the display of accuracy and skill.

I made one of these discs of $\frac{1}{16}$ in. manganese steel turned true on both sides. The studs or pins are of brass, the lines are engraved, and the lettering is etched with nitric acid, all of which processes will be found clearly explained in back numbers of WORK.

MEANS, MODES, AND METHODS.

BAG-PORTMANTEAU LOCKS.

MANY of our readers may have observed the great similarity in the style of locks usually fixed on travelling-bags, portmanteaus, dressing-cases, hand-bags, and the like. They seem to divide themselves roughly into two classes—bag locks, and box or portmanteau locks. Of bag locks the quality seems, as a rule, very poor, and the type of key always, or almost always, the same. Once, at Paddington, I encountered a youth who was in tears because his money was locked up in his Gladstone, and he had left his keys behind him; he was trying vainly to force the bag open, when I offered him my key to try with; to his surprise it opened it at once. I was not in the least surprised, as when I bought my own Gladstone I noticed that all the keys in the shop were practically interchangeable, there being, however, two sizes, one for small hand-bags, and the other for bigger hand-bags and Gladstones. As I was then on the point of going abroad, I wished for a better lock: the shopman offered to have the lock altered and new keys fitted, but as it was rather expensive, and would have detained me too long, I resolved to alter the lock myself.

As my bag is now, after ten years, quite invalided and useless, I will explain the method I adopted, to which anyone is welcome.

After due consideration, I removed the lock, or, at any rate, that portion of the lock that was not riveted on to the iron framework of the bag; then I took out the pin which goes into the barrel of the key, and in its place inserted a brass pin nearly half as long again. After this I bored out the key barrel with a Morse twist and drill to a corresponding depth.

In addition to this, I filed down the movable portion of the lock (viz., that on which you press to open the bag) until it was level with the collar which surrounds it.

Then, on putting the lock together again, I had a lock doubly secured against inquisitive persons. It could not, even when unlocked, be opened with any pressure from fingers—pressure from some hard instrument being absolutely necessary. When locked it would have required a key bored out in a similar manner to mine—or a skeleton key—to open it; and in all my numerous travels I have not found that it has been tampered with, or, at any rate, opened.

Of portmanteau or travelling-box locks

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there is not much to say in a general way; they are of better quality—lever locks, as a rule—and there seem to be about half a dozen types. A good portmanteau is usually sold with two keys, one made of iron in the usual way, and the other of brass or gun-metal.

I may mention here that the best way to open a portmanteau if your keys are left at home, lost, stolen, or strayed, is to cut through the copper rivets by which the lock is fastened to the leather, or else to file the burred portion down, when the lock will easily come off, and can be as easily fixed on again after being unlocked. In many cases it is simpler to take off the hasp in the same way, *i.e.*, by removing the rivets; or, better still, by knocking out the pin in the hinge of the hasp, if it should be practicable.

About the locks of hat-boxes, *i.e.*, the ordinary circular abominations which hold a hat only, and nothing else, the less said the better. The locks seem to be very common, and of one type only, and, in consequence, any one man's hat-box key will fit any other man's hat-box.

Despatch-boxes, jewel-boxes, and the better quality of dressing-cases and bags, as supplied by good makers, are, as a rule, equipped with locks of much better quality, often, indeed, with so-called Bramah locks, often with the very ingenious Yale locks, which are unpickable by an ordinary person.

H. J. L. J. M.

My Speaking-Tube.

When first I started housekeeping, now some years ago, the room that was given up to me as my workshop (or "pig-room," as my women-folk used to call it) was right at the top of the house.

This was an advantage to the household, as the noise of my metal working was minimised, but a disadvantage to me, as there was no bell in case of my wanting coal or anything brought up at odd times; and I was obliged in consequence to go up and down more often than I cared to do. There were already two separate instalments of electric bells in the house, and a third was out of the question; a telephone occurred to me, but, as that required two electric bells in conjunction with it, I bethought myself of a speaking-tube. After jotting down the various things I required, I found it was undoubtedly a cheap, perhaps the cheapest, mode of communication with the downstair regions, and in a short time the installation was fixed complete.

In the course of my inquiries at various shops, I found that the prices of fittings varied to a surprising extent. One firm on whom I called offered to put one up at 1s. per foot, all complete: as I wanted fifty feet or thereabouts, I should have been poorer in the end by £2 10s. This would not do for me at all. Everybody seemed unanimous in recommending tubing an inch in diameter, but, by experimenting at a friendly ironmonger's shop, I found to my joy that ¾ in. or ⅞ in. compo. pipe answered the purpose admirably. I chose the ⅞ in. pipe, as it was rather stouter and stood bending better than the smaller size. The lot of tubing was in one piece; but, unable to put it up single-handed, I cut it into two or three sections, each of which alone was perfectly manageable. The tubing was fixed along the woodwork of the banisters in the mouldings, where it was least obtrusive to the eye, by means of staples. Joints were made by means of red-rubber tubing: it cost more than the white certainly, but is cheaper in the end, as a longer time elapses before it becomes perished by exposure to the air. The whole tube when finished was varnished with a spirit varnish, coloured to suit the graining of the stairs.

The fittings or mouthpieces I picked up second-hand for a very small sum; they were large, being made for 1 in. tubing; but I turned down some cotton reels till they fitted the mouthpieces quite tight, and I turned out the holes in their centres to fit my ⅞ in. tubing. My speaking-tube had to go round several sharp corners and bends, but the bends did not hinder the passage of sound in any material way.

The whole installation did not cost more than 6s. or 7s., and was so satisfactory that I put up another from the morning-room to the kitchen.

For the first day or two the sound of the whistle was grand fun for my two terriers, who are always glad for something to bark at; all the same, they were mightily afraid of the tube (no doubt thinking it a diabolical invention), and always refused to be conciliated by any expressions of goodwill if conveyed down the (to them) unspeakable tube.

H. J. L. J. M.

OUR GUIDE TO GOOD THINGS.

*** *Patentees, manufacturers, and dealers generally are requested to send prospectuses, bills, etc., of their specialities in tools, machinery, and workshop appliances to the Editor of WORK for notice in "Our Guide to Good Things." It is desirable that specimens should be sent for examination and testing in all cases when this can be done without inconvenience. Specimens thus received will be returned at the earliest opportunity. It must be understood that everything which is noticed, is noticed on its merits only, and that, as it is in the power of any one who has a useful article for sale to obtain mention of it in this department of WORK without charge, the notices given partake in no way of the nature of advertisements.*

106.—Starley's Coventry Chair.

Messrs. J. K. Starley & Co., Limited, Meteor Works, West Orchard, Coventry, the well-known makers of the well-known "Rover Bicycle" and "Coventry Chair," have produced in the latter a machine which cannot fail to find favour as a conveyance for invalids, or for any lady or child whom the rider may desire to take with him on any pleasure trip. The general appearance of the "Coventry Chair" may be gathered from the accompanying illustration, in which it is utilised as a means of locomotion either for a sufferer from recent illness who has reached the period of convalescence, or one whose confirmed weakness of body is such as to prevent him almost entirely, if not wholly so, of using any sustained exertion on his own account. Technically speaking, it may be described as a front-steering tricycle chair, with 40 in. side wheels and 22 in. front wheel, all furnished with 1 in. tyres. It is fitted with patent double-driving gear, and has ball bearings to all running parts, cranks, and pedals. The body of the chair is light, being made of wickerwork, but it is also strong, despite its lightness, and handsome in appearance. It is upholstered in blue cloth. Its powerful brake places it at all times well under the control of the rider, and, in addition to this, the seat and handles are adjustable. It should be said that the wickerwork of the body is varnished. The other parts of the chair are enamelled and tastefully lined in colour, all bright parts being painted. The price of the "Coventry Chair" in the styles just described is £33, but those who may prefer a wooden body can have a machine thus fitted, the body being painted and lined in two colours, for an additional sum of £3 10s., making the entire cost £36 10s., but it must be borne in mind that the machine with a wicker body would certainly be the lighter of the two. It is needless for me to point out that the makers are Messrs. J. K. Starley & Co., Limited, for their specialities in Rover Safeties, Rover Sociables, and Roamer Tricycles, as well as in the Coventry Chairs now under consideration, are so widely known and so highly esteemed in the wheel world as to render any remarks of mine on their merits as makers of machines wholly unnecessary and superfluous. That the Coventry Chair fully meets the requirements of those who move in the inner circles of society is shown by the testimonial given to Messrs. J. K. Starley & Co. by His Grace the Duke of Argyll, who writes, "Your 'Coventry Chair' has been tried by the Duchess. She has found it most comfortable." Medical testimony in its favour is also very strong, for a Malvern practitioner, who has himself taken an invalid for several rides in one, declares it to be so roomy and comfortable that invalids may be said to "repose" in it, while the strong springs and cushion tyres with which it is furnished "make vibration almost unfelt." Which means that a patient can, by means of this chair, obtain exhilarating exercise which is utterly unattended with fatigue, and in which the jolting that is inseparable from the ordinary Bath chair is either reduced to an inappreciable minimum or altogether unfelt. Turning from this to its capabilities for the conveyance of a companion and a considerable quantity of luggage over many miles of country in a journey extending over some days, a gentleman engaged in business in the City of London tells the makers that, although he is by no means a strong man, he was, nevertheless, able to work one of the "Coventry Chairs" from Redhill, in Surrey, to Devonshire and back, laden with, let us presume, a lady weighing over nine stone, and half a hundredweight of luggage, himself riding behind and acting as the motive power, at an average of about forty miles per day, without any fatigue or undue exertion. From these facts powerful arguments can be drawn in favour of its adoption in towns and health resorts as a substitute for the old Bath chair, and as a means of conveyance certainly preferable in the case of ladies to the Sociable, especially when the lady, for various reasons, may not be willing or able to take her due share of the work of propulsion as in the case of the latter. Messrs. Starley & Co. are now sending out their illustrated catalogue for the season 1891.

Starley's Coventry Chair.

THE EDITOR.

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SHOP:

A Corner for Those who Want to Talk It.

*** *In consequence of the great pressure upon the "Shop" columns of* Work, *contributors are requested to be brief and concise in all future questions and replies.*

In answering any of the "Questions submitted to Correspondents," or in referring to anything that has appeared in "Shop," writers are requested to refer to the number and page of number of Work *in which the subject under consideration appeared, and to give the heading of the paragraph to which reference is made, and the initials and place of residence, or the nom-de-plume, of the writer by whom the question has been asked or to whom a reply has been already given. Answers cannot be given to questions which do not bear on subjects that fairly come within the scope of the Magazine.*

I.—Letters from Correspondents.

Canvas for Canoe.—Lineno writes:—"In reading Work, No. 80, page 485, I see there is a reply to an inquiry for the best canvas for a canoe. It states that No. 1 canvas would be the best, which is very indefinite, as there are several kinds of canvas—viz., cotton for paper-hangers, jute hessian, tow hessian, flax, and dowlas for artists, all commencing at No. 1, and going upwards according to weight and fineness. I send a few samples, with names and widths made, which are largely used by carriage and van builders where they require strength and lightness. The samples are only procurable at heavy linen establishments. The following are the particulars as to sizes made of the canvases, samples of which have been sent:—Loom dowlas, made in widths of 30 in., 36 in., 40 in., 45 in., 70 in., 80 in., and 90 in.; tow hessian or canvas, made in widths of 36 in., 54 in., and 72 in.; flax canvas, made in widths of 27 in., advancing 3 in. to 6 in. up to 70 in.; sail cloth, made in widths of 24 in. and 36 in."

Austin-Leclanché Battery.—J. W. (*Homerton*) writes:—"I have much pleasure in telling you I have made an Austin-Leclanché battery, and I am very pleased with its working. I have put it on my door bell, and although rung several times during the day I find no difference in the sound. Thanks to Mr. Austin for his article."

To cut a Round Glass Bottle in Two.—S. R. (*No address*) writes:—"Get a piece of wool and tie it round the place you want it to break off by, then pour a little paraffin oil nicely all round the wool, so as to saturate the wool with the oil, by means of a spoon or a small bottle; light the wool with a match, and let it burn all round (giving the bottle a little turn): this will make the place where you tied the wool round very hot. When it has burned all round, dip it into a jar of cold water and it will give a crack, then give it a little tap and the bottle falls in two."

"Seal" Engines.—A Subscriber from the First writes:—"In Work, No. 87, page 568, you give an illustration of a half-man-power Seal gas engine. I shall be greatly obliged if you will let me know if they make them in larger sizes, say half or three-quarter horse-power, and the cost complete with water cistern."—[Probably Mr. Seal will answer this correspondent by advertisement in Work or otherwise.]

A Useful Paste.—L. S. L. (*Kirkcaldy*) writes:—"I find ordinary flour paste, made of the very finest wheat flour, in which a small quantity of fine white sugar is dissolved, and afterwards, while cooling, a few drops of carbolic acid is stirred, keeps good for any length of time. The proportion of sugar should be about one-fourth of the flour. I have used this paste standing in an open jar for months."

Lectures in Drawing.—The Rev. J. A. F. (*St. Mary's Working Mens' Club, Chalton Street, St. Pancras, N.W.*) writes:—"It may interest you to know, and may lead to the formation of similar lectures in other districts, that a course of lectures on elementary drawing are being given in connection with the above club on Wednesday evenings, at 8.15, free to all members of the club. The lecturer is Mr. A. R. Jemmet."

"Our Eyes."—J. B. (*Strand, W.C.*) writes:—"The price of this book is 1s., not 6d., as stated in Work, page 567, Vol. II."

II.—Questions Answered by Editor and Staff.

Electrical Machine.—Querist.—This correspondent has made a very effective electrical machine out of a "sugar-stick bottle," a few bits of iron and wood picked up from a scrap heap, and other homely materials. It gives sparks ½ in. in length, and with these he charges a fulminating pane made by himself out of glass, tinfoil, and varnished paper. With this he can do a lot of experiments, and provide much amusement in the dark winter evenings.—G. E. B.

Camera Obscura.—Amateur.—The reference (see No. 75, page 403) is incorrect. A shutter working up and down fixed behind the lens can be liberated from the outside by means of a lever; the shutter should, of course, be one of the self-setting kind.—D.

Spongy Platinum.—Querist.—You cannot make a piece of platinum spongy. Spongy platinum is prepared from a solution of platinic chloride by precipitating the metal with sal-ammoniac solution as a double chloride of platinum, and then heating the pasty precipitate in a crucible until it becomes spongy. It will be cheaper for you to buy than to make it.—G. E. B.

Carpenter's Bench.—G. H. (*Paddington*).—In asking for a description of a carpenter's bench, you ask if an iron one is known to me. Yes; there is an iron-framed bench (see page 235, Vol. I.) sold by Mr. Syer, of Wilson Street, Finsbury, but the writer has no experience of it. As several of your friends are waiting for this information, I shall describe a wood-framed bench. I should suggest that you make the bench not less than 5 ft. at the shortest: the labour would be scarcely any more, and the usefulness greater. For amateurs' work, a bench resembling a cabinet bench would be more useful; but we will try to embody as many useful appliances as possible. If you are careful, and do not object to the expense, have an "instantaneous grip vice"; but if not careful and gentle, have an ordinary wood screw. Cabinet-makers' and amateurs' benches should be a trifle higher than carpenters', owing to the thinner boards dealt with by the cabinet-maker, and usually finer work; in any case, make the bench 2 ft. 9 in. high: you can easily cut an inch off if it proves too high; 2 ft. 8 in. suits me well, and I am of fair height, though for some work I find a higher bench beneficial. Make the legs of good white or yellow deal, 3 in. square, or 3 in. by 4½ in. These should have a cross-rail, 3 in. by 2 in., connecting each in pairs, morticed and tenoned together: tenons, of course, on the rails, being 3 in. by 1 in.,

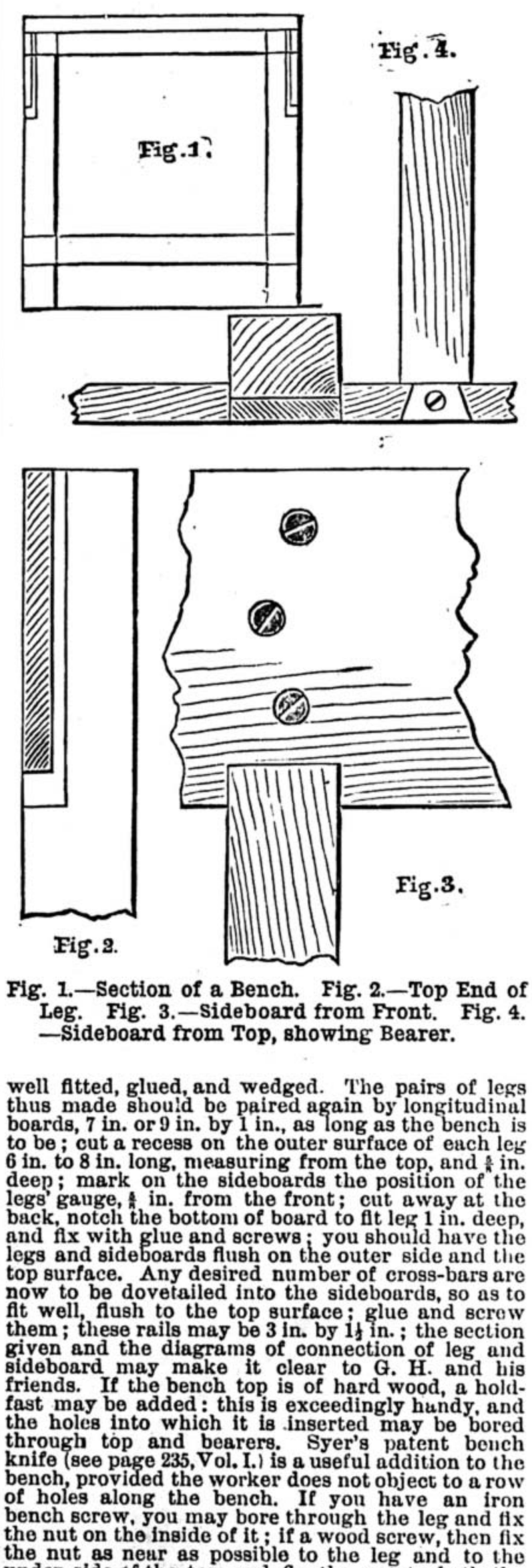

Fig. 1.—Section of a Bench. Fig. 2.—Top End of Leg. Fig. 3.—Sideboard from Front. Fig. 4.—Sideboard from Top, showing Bearer.

well fitted, glued, and wedged. The pairs of legs thus made should be paired again by longitudinal boards, 7 in. or 9 in. by 1 in., as long as the bench is to be; cut a recess on the outer surface of each leg 6 in. to 8 in. long, measuring from the top, and ¾ in. deep; mark on the sideboards the position of the legs' gauge, ¾ in. from the front; cut away at the back, notch the bottom of board to fit leg 1 in. deep, and fix with glue and screws; you should have the legs and sideboards flush on the outer side and the top surface. Any desired number of cross-bars are now to be dovetailed into the sideboards, so as to fit well, flush to the top surface; glue and screw them; these rails may be 3 in. by 1½ in.; the section given and the diagrams of connection of leg and sideboard may make it clear to G. H. and his friends. If the bench top is of hard wood, a holdfast may be added: this is exceedingly handy, and the holes into which it is inserted may be bored through top and bearers. Syer's patent bench knife (see page 235, Vol. I.) is a useful addition to the bench, provided the worker does not object to a row of holes along the bench. If you have an iron bench screw, you may bore through the leg and fix the nut on the inside of it; if a wood screw, then fix the nut as near as possible to the leg and to the under side of the top, and fix the nut to both the sideboard and to the leg and top, or a vigorous amateur screwing up a narrow strip will force the sideboard away from its place. When it is remembered what leverage the bench screw handle gives, this is not surprising. If I had another bench to make for myself, I should certainly have a screw at the rear end, like that sketched in Work, as a "Slojd" bench (see page 797, Vol. I.): this would help to convert the bench into a carver's bench, a project, however, on which I have a paper in hand. If a pair of diagonal struts are placed under the bench from standard to standard, well fixed, and a bolt through the crossing—thus X, it will materially strengthen the structure, and a shelf nailed upon the lower cross rails is very handy. For supporting boards while shooting the edges, a turned and tapped wood screw is very useful, and it can be also used on the top to abut any piece of wood while sawing a shoulder, etc. The slide and its casing should be fixed truly square, the slide having three tenons fitting into mortices in the movable portion of the bench vice, the casing for the slide square to the sideboard in each direction, and parallel to the underside of top. For another ingenious device for the bench, please refer to page 299, Vol. I. This seems, from the description, to be a capital thing. I for one should like to see an example in use or on show in London.—B. A. B.

Paging of Work Parts.—J. M. McB. (*Westport*).—What you suppose is an error in the paging of your parts is really not so. Refer to Work, No. 79. You will find that the four-page supplement of "Shop" is paged correctly between pages 438-443. So they should be bound—if you bind your numbers; and you should.

Works on Perspective.—You should get either of the following books:—Davidson's "Practical Perspective," 2s., Cassell & Company; or Spiers' "Architectural Drawing," 10s. 6d., Cassell & Company.

Draughtsman's Work.—G. P. (*King's Lynn*).—Instructions on this subject will, in all probability, be given in Vol. III.

Adjustable Scribing Block.—W. S. (*Dover*).—The principle of this invention has been covered by one Montgomery, in a U.S. patent granted to him, but as we have not seen the specification, we cannot say what is included in the invention. It is pretty clear that the *object* of both inventions is similar, and it would be needful to compare the description and claims of the U.S. patent with what and how W. S. purposes to carry out his plan, so as to see clearly what is open for him to do, and thus enable him to avoid trenching on other rights—which, if not granted in this country to the American, are now published here, so that they are public property.—C. E.

Engraving Seal Stones.—Improver.—This engraver wants to know the way in which letters, etc., are put in stones of signet rings. A complete answer to this, and detailed descriptions of tools, powders, lathe, etc., used in this art is to be found in Vol. III. of Holtzapffel's "Turning and Mechanical Manipulator," pages 1318-1365, under the head of "Seal Engraving." The book is now out of print and under revision, so Improver will have to apply at some public library for it. It is worth a little trouble to obtain; for this particular article is based on the practice of one of the best of our London seal engravers—Mr. Warner. The following is a summary of the process:—In the first place, the lathe, which is a small one, is made so that the "tools" can be fitted in. These are of soft iron rod or wire, with ends generally in the shape of beads or discs, the diameter of the largest disc being rarely more than $\frac{1}{10}$ in. These are made to revolve rapidly, and are generally charged with powdered diamond dust, lubricated with oil of brick. With these minute wheels or discs, the stone is ground out to the depth and shape required. A good idea of the process is to be obtained at many public places—such as the Crystal Palace and the Aquarium—where men are at work engraving glasses, etc., with names while you wait. The machinery and materials are much the same, but modified to suit the glass, which, is of course, softer than the generality of seal stones. Cutting tools in the forms of gravers, scorpers, punches, etc., are of no use, neither is acid.—H. S. G.

Wire-Work.—Rat-Trap.—I give some addresses of firms who supply wire. I know of no book on flower-stand and rat-trap making; but a serviceable series of articles treating with plain and ornamental wire-work in a practical manner are about to appear in Work. One of the papers will deal with the articles you specify. Messrs. Cicero and Co., Clerkenwell Road, E.C.; Messrs. Thomas, Edgware Road; or Mr. W. Hughes, 57, Drury Lane, W.C., will supply you.—J. S.

Coach Painting—Cane-Work in Panels.—H. W. (*Strabane*). Imitation cane-work in its many varieties, imitation wicker-work with open spaces showing the ground colour of panel, is seldom done with pencil or tube now; it is prepared in large sheets stamped out with most accurate form of mesh and embossment of one line overlaying another, so that it stands up in relief almost as high as the actual cane or wicker-work. It is varnished over on the side to adhere to the panel, and pressed on, and a coat of varnish over all cements it thoroughly to the panel. Before this invention, camel-hair pencils, air-tubes, and wheel-tubes were used, and as it is a good exercise for eye and hand, and some may like to know how it is done, the following details will show that it is simple enough, only needing patience and a steady hand. Having determined your pattern and size, mark off with compasses on the panel the double horizontal and vertical lines from the mouldings of panel; lay

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these on first, using a straight-edge lath for the finger-guide or for the tube-wheel (the air-tube clogs, and does not answer so well). Be sure you work from the top downward, then you will not smear your work. Having done the longest horizontal lines first, let them dry. Drying colour may be made of a turps colour mixture—say, a wine-glassful—to which is added a tea-spoonful of quick drying varnish, and a quarter of a tea-spoonful of linseed-oil (never use boiled oil in carriage painting), making it like thin cream. Now work the double vertical lines from right to left of your panel; when these are dry—say, in an hour or two—put in the single diagonal lines in one direction first; leave these a little longer to dry, and then finish off in the cross diagonal direction. When dry, the broad-edge cane is put in the angle of the moulding: this covers up all the endings of lines; if you wish for effect, you may add the "ties" which, in real caning, hold down the broad-edge cane, and you may shade them with a darker tinge on one edge. A coat of clear copal varnish completes the job. The tube-wheel is a most ingenious tool: it is as a syringe in shape, with a small rowel-wheel in the point; the syringe or tube part is filled with colour, and attached to one leg of a pair of compasses, to serve by the other leg as the guide-fingers of the painter's hand. It acts as does a lawn croquet marker, and the revolving wheel, about ⅜ in. diameter, draws down the supply of paint from the tube and rolls it along the panel. The paint dries so quickly that it must be frequently supplied, and every part of the tool, wheel, etc., is cleaned off with turpentine before it is put away. The only place I know where this wheel-tube is to be bought is at the large coach trade furnishing warehouse, Whittingham & Wilkins, 136, Long Acre, W.C. The price complete is 15s. 6d. This firm deals largely in colours prepared for use, and the sheets of imitation cane and wicker-work.—J. C. K.

Frosting.—XMAS.—Powdered glass is what is applied to cards to give them a frosted appearance; it can be made by heating glass red hot, plunging it at once into cold water, when it breaks into powder; it is then sifted and dried. Do you wish to make the cards for trade purposes, or simply a few for your own use? Whichever way, you ought to experience no difficulty in getting it at a local glass-blower's; or you can write to Messrs. J. Powell and Sons, Whitefriars Glass Works, Temple Street, London. It is very cheap, and weighs light; 1 lb. would be sufficient to frost several hundreds of cards.—W. E. D., JR.

Decorated Tin Sheets.—H. B. (*Brixton*).—You can buy these from the Decorated Tin-Plate Company, Neath.—R. A.

The Art and Craft of Sign-Writing.—C. M. (*Gloucester*).—"The Art and Craft of Sign-Writing," by Mr. William Sutherland, originally published at 15s., and now, owing to its scarcity, raised in price to one guinea, may be obtained from Mr. W. G. Sutherland, "The Journal of Decorative Arts" Office, 15, St. Ann Street, Manchester. There are only a very few copies left of this valuable work, and I therefore advise early applications for same, as, owing to the heavy cost of producing the coloured sheets of alphabets, etc., it cannot be reprinted, and a fresh edition issued. This work will in time become very valuable.—H. L. B.

Painting Advertising Boards for Lettering Purposes.—CALIGRAPH.—If you have taken your contract at a fair price, you must turn out the boards in a fair workmanlike way, so that they will withstand the ravages of sun, wind, and rain for a reasonable time. There are many makeshift ways of stopping up the pores of the wood, but in using them the work would soon become valueless. Nothing can beat a good stiff coat of priming, properly mixed, and containing in equal parts the best red and white lead. Two good round coats of paint upon this should then present a pretty fair ground for lettering upon. For temporary purposes, you may give the boards a coat of size, or better still, ordinary ceiling whitewash—*i.e.*, size and whiting, which, when dry, should be rubbed down with fine glass-paper and the boards well dusted.—H. L. B.

Technical Classes.—D. H. J. (*Balham*).—A reference to your local directory should give you the information you seek. However, apply to the City of London Guilds and Technical Institute, Finsbury, E.C., as to its branch classes.

Rimering Tools.—W. E. (*Birmingham*).—You will turn the tool all over to obtain the blank outline, file the teeth to shape, and temper by first getting red hot, then dipping in oil to let down the heat a little, and then transferring to cold water, where it will remain until quite cold. The teeth will be sharpened with an emery wheel.—J.

Sheet Iron.—S. T. (*Kensington, W.*).—Butterworth Brothers, Marsh Street, Bristol, supply this.—J.

Polish on Steel.—There is nothing better than fine emery.—J.

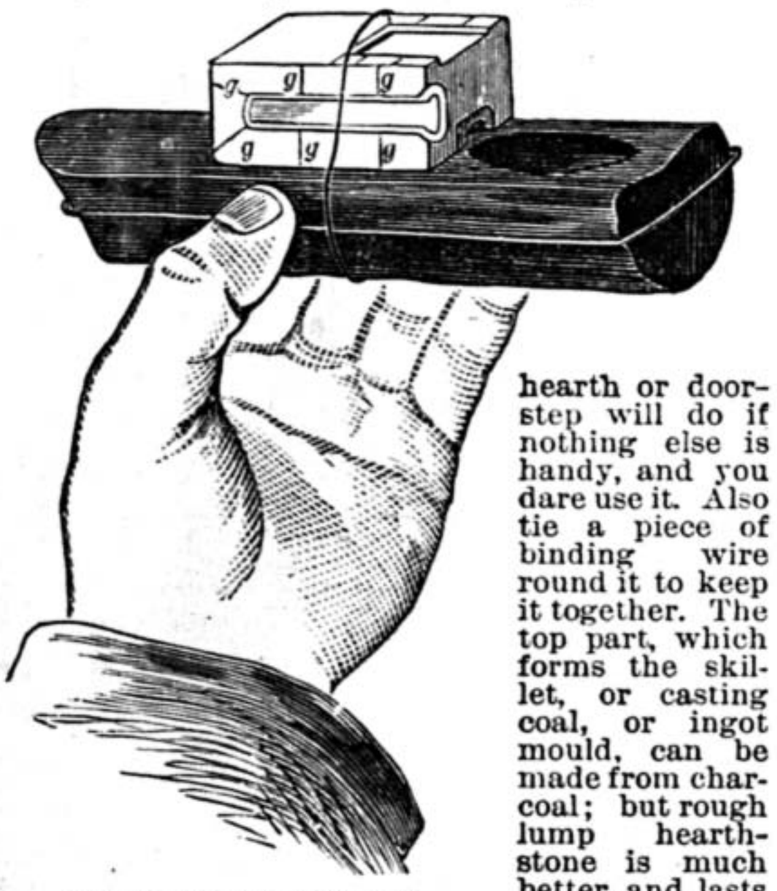
Designs in WORK.—E. B. M. (*Tunbridge Wells*).—At present, sheets of designs at extra charge are not contemplated.

Iron-Work.—APPRENTICE.—You should procure "Iron-Founding," by Wylie, 5s., Spon & Co.—K.

Work on Plumbing.—BALL VALVE.—You should procure "The Plumber," etc., 1s., Houlston and Sons, Paternoster Square, London.

Patent Fire-Light.—PETRO.—You should search the Files of Patents, at the Patent Office, Chancery Lane, London, E.C., to see if a patent such as yours has been registered already.

Melting Gold in Small Quantities.—INDEX.—In a previous answer to this same correspondent it appears that I left out the very part he "wanted minute details about." I will gladly attempt to supplement the answer in WORK, No. 74, page 357, and tell him how to run down a few pennyweights of gold ready for forging into shape. All of this might have been given before if INDEX had only taken the trouble to say what he *did* want when writing to our Editor. Now for business. Here is a sketch of the simplest, easiest, and cheapest arrangement for melting small quantities of gold, and it is one that has stood the test of ages, so it is old-fashioned; but that is no reason why it should not still be used—at least, until one deals with larger quantities, when Fletcher's new arrangements can be employed with advantage. I will briefly refer to these at the end of this answer. The sketch shows that this arrangement is composed of two separate pieces tied together with wire, one of charcoal, the other of hearthstone (or charcoal). The lower long piece is formed from a nice piece of sound spring wood charcoal, ground quite flat on one side with a shallow hollow scooped out as a receptacle for the gold while being melted. The bow of the dividers or a piece of clock spring answers well for making the hollow, and as for grinding the charcoal flat—well, that can be done on any decent size piece of level stone; the kitchen



Melting Gold in Small Quantities.

hearth or door-step will do if nothing else is handy, and you dare use it. Also tie a piece of binding wire round it to keep it together. The top part, which forms the skillet, or casting coal, or ingot mould, can be made from charcoal; but rough lump hearthstone is much better, and lasts longer. The hard pieces are the ones that are to be chosen for this purpose, and as a rule the lumps are too large, and therefore should be cut into two or four portions. Each portion is then to be ground flat on one or more sides, ready for cutting or filing out a smooth groove or hollow of the shape and capacity desired. For example, if our few dwts. are for making something wide, such as the backs of collar studs, then our piece of hearthstone will be hollowed out like the one drawn on the top side of sketch; but if for wire or narrow work, such as a wedding ring, then the hollow should be like the one at the side of the top piece. This latter is really the shape for your job, and you are to suppose that one exactly similar is tied down flat on the charcoal. It hardly seems worth while going into measurements, because two or three meltings will teach all that; to be quite on the right side, make your ingot mould—that is, as you know, the hollows I have been writing about—full large. It is well to have the mouth rather wide so that the molten metal will be sure to run in. And see also that the sides of the mould slope inwards a little, else it will be broken. Make it relieve, in short. Even now it is hardly finished, for it has to fit on a flat charcoal, and being flat itself, it follows that some measures should be taken to allow the air to escape, or else we shall find that the metal has not filled the ingot. It is an easy matter—merely two or three slight grooves, filed or scratched across from inside to outside, being quite sufficient. They are shown on sketch and marked *g*. Instead of this, one finds that a piece of flatted iron of suitable depth, shape, and capacity answers very well when lightly greased and tied between two pieces of charcoal. Before proceeding to melt our gold, the greatest care should be taken to have both parts quite dry, for if there be any moisture about, the gold will spit all over the place. So, to sum up, we have now quite ready for tying together—first, a piece of charcoal, one side flat and hollowed out at one end for the gold; secondly, an ingot mould, of either hearthstone or charcoal or iron. If either of the former, it must be quite dry, and should relieve; if the latter, then slightly greasing suffices. The sketch indicates the rest of the minute details, I think. By it you see how it is held so that it can be easily tilted back to run the gold in. If your coals do not fit, then you will be reminded of it by finding the molten metal run either over the side or into your hand. Now a safe precaution for taking care of the gold is to have a basin of clean water underneath to catch any that may run over; otherwise, an hour's grubbing on the floor picking up minute grains will be spent. A small piece of borax should be used as a flux, and either the mouth blowpipe or one driven by bellows, just whichever you have. I wish you every success in making rings, or, in fact, anything else from odd pieces of gold. I know that the chances of obtaining workable gold are against you, particularly if every atom of lead or silver solder, etc., etc., is not taken out before melting. If it is your idea to have such a wedding ring hall-marked, then add some fine gold over and above what you believe to be the exact quality, otherwise the Hall may smash it up, as they are empowered to do with all work of inferior standard. Just a few words in conclusion with reference to other and improved methods of melting. They are the production of Thomas Fletcher & Co., Thynne Street, Warrington, and the only one I have space to refer to here is what is called Fletcher's new melting arrangement for melting gold or silver rapidly without the aid of a furnace. In this, the two parts of the ingot mould slide on each other to enable ingots of any width to be cast. The blowpipe is part of the rocking stand. A blower, which costs 21s., connects to an upper tube and the gas to a lower tube. The metal is melted in a shallow crucible and the whole apparatus is tilted until the ingot mould is filled. The price of the small size is 13s. 6d., and that melts 3 oz. The crucibles cost 4d. each. There are other patterns and sizes; but this will give an idea of the cost. The firm will send you a catalogue, I do not doubt, if you think of getting one of these stoves. For my own use I have an injector furnace that gives perfect satisfaction, and melts a few dwts. or 20 oz. without any trouble.—H. S. G.

Verge Watch.—BIRMINGHAM.—Go to any watch tool shop—say, Messrs. Swinden & Son, 27, 28, 29, Temple Street—take the verge, the cock, and plate, and ask for a hairspring to suit; also cock-screw. By taking the verge with balance, they will be able to guess very nearly the strength it should be, and by taking the plate they can see the diameter it must be. The screw they will give you will probably be a grey one, perhaps too thick in the head and too long, so that it goes through the plate and projects; if so, cut it off to the correct length, and reduce the head till it is just flush with the cock; see the saw cut is all right, make it red hot and drop it in oil, take out and nicely polish the head, and let the colour down to a blue, and there you are.—A. B. C.

Violin Making.—PAUL JONES.—Papers on this subject are in hand, and only await an opportunity for publication.

French Clock Repairs.—COUNTRY AMATEUR.—Are you sure you gave me the correct number of the wheels and pinions of your clock, the 'scape wheel of which is broken, as by calculating I find it would be a very short pendulum, and if so, it would be one of those cheap common ones that would not pay to convert to watch escapement? However, taking your figures as correct, I find on calculating the following result:—$96\times84\times(45\times2)\div7\times7\div60=246{\cdot}85$ vib. per hour, and $141120{\cdot}0\div246{\cdot}85^2=2{\cdot}32$ in. as being the length of your pendulum at present; now, is that correct? Now the escapement you have bought; how many vibrations per minute does the balance make? There are three different trains—18,000, 16,200, and 14,400 per hour. If we take the middle number, then I think by taking off the present 'scape wheel of 45, and putting on one of 20, to suit the 'scape pinion, that will give 16,457 vibrations per hour; you might manipulate the hairspring to make it keep time. To fit up the escapement you must cut a piece out of the plate to let the 'scape pinion down through for the wheel to work in; hold it in position, and try the depth of the new wheel, working in 'scape pinion; scratch slightly all round the platform; now drill a hole through platform and plate, and fit a screw, and see that the depth is all right before drilling the other screw holes. If you put four screws, you need not have steady pins unless you have to draw the holes to correct the depths, when, perhaps, it will be best; if you find the length of pendulum in my calculation is not the length of it, see if your figures are the correct numbers for wheels and pinions; if not, give me the correct ones, and I will go over it again. I have a horizontal clock to pieces now, and I find the train of that is as follows:—viz., second wheel drives dial work and revolves once for three hours: 75 reckon 25 in calculating as follows:—$25\times60\times60\times55\times(15\times2)\div$ pinions, $16\times8\times8\times8=18000$ train. From this you will see that the wheels are of a lower, and pinions of a higher, number than yours, so that helps me to think you have made a mistake.—A. B. C.

Cardboard Letters.—YOUNG CHIP.—For these apply to Willcox Brothers, Blackfriars Road, London.—S. G.

Unpickable Lock.—H. D. (*Grasmere*).—I do not think any locksmith would be willing to make the lock for the amount you mention; it would have to be hand-made throughout, and would require a great amount of time expended on it. It has never been patented, and may possibly have been taken up by some lock manufacturer. Locks made by Messrs. Hobbs, Chubb, and other makers, are practically unpickable, and could be purchased through any ironmonger; would not these suit your purpose?—T. W.

Improved Key.—W. E. W. (*Brixton*).—Your idea is not a bad one, and would prevent the pipe

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getting stopped, but it would considerably weaken the key to drill it through to the bow. Submit it to some well-known maker.—T. W.

Melting Lead.—J. W. (*Thornhill*).—Use resin as a flux when melting lead; well skim the dross off as it rises, and do not let it get red-hot. Could you not run it out in upright moulds or pigs? the sponginess would then only be on a small surface, and could be easily cut off.—R. A.

Missing Pages in August Part of Work.—A. H. W. (*Brighton*).—You should write to the publishers, Cassell & Co., Limited, London, E.C.

Taking out a Patent.—E. J. (*Ely*).—Write to the Patent Office (25, Southampton Buildings, Chancery Lane, London, E.C.) for the "Official Circular of Information." It will be sent post free, and, among other points of importance, you will learn how to ascertain if you are first in the field. The drawings submitted will do for the Patent Office if drawn firmly in good black Indian ink, and on paper kept from creases. So far as possible, apply the same letters of reference to the same parts in all figures—this greatly facilitates the comprehending of a description. In describing your invention, use the first person "I" freely; and don't confine yourself to one material when others will serve the same purpose. Keep tracings of your drawings. Decidedly you can sell your invention before finally patenting it. It is impossible to say what your patent is worth. Call your invention, "a movable appliance with reel and line to aid in the striking of chalk lines." The same principle was applied some forty years since to movable pegs for hatters, drapers, etc.; but we are not aware that it has ever been utilised in the way in which you propose to apply it.—C. C. C.

Fretwork Machine.—W. S. (*Stockport*).—You should purchase the Index to Vol. I. of Work. In it you will find references to a host of easily made fret machines. Try and convert one of these for your own requirements.

Tuning Dulcimer.—T. C. B. (*Birmingham*).—By tuning the fourth note on the right-hand side of the left-hand bridge to C you have tuned your dulcimer in the key of G, exactly one note higher than the pitch intended, F. This increases the brilliancy of the tone, and it points to the fact that you have done your work well, or the instrument would not stand the extra strain due to the increased tension. The only objection to it is that the wire, unless very good, is likely to break and cause trouble. To obtain the correct pitch you must tune the first string on the left-hand side of the left-hand bridge to the pitch of your C fork, and this will bring the first note of the scale, which is on the right of the same bridge, to the proper pitch, F. You must understand that (with the single exception of the bass one) all dulcimers, no matter what their pitch, are tuned to the scale of G—that is to say, the first note is always called G, although it may be any other; in the same way that the first note on the flute (all finger holes closed) is always called D, no matter what the size or pitch of the instrument may be. As you have raised your instrument above pitch, I should not advise you to drop it again, but allow it to settle itself, which it will soon do if played on frequently; and as it "comes down," instead of raising it when tuning, simply "level" it until the proper pitch is arrived at. With regard to the "scale being incorrect," it is probably owing to the fact that many of the dulcimers in use in the Midland counties are "diatonic," and most likely the tuner who operated upon yours had never before seen a "chromatic" one, and was therefore considerably puzzled over it.—R. F.

Organ-Building Book.—G. J. E. (*Burley*).—You should get "Practical Organ Building," by Dickson, 2s. 6d., Lockwood & Co.; or "Organ Building," by Wicks, 3s. 6d., Ward & Lock.—K.

Telephone.—X. Y. (*Rochdale*).—You have altered the arrangement very materially from what you spoke of first. I advised the mechanical telephones because I thought it would suit your first arrangement best; but now I feel inclined to advise the other form. There is nothing to hinder a man of your abilities to make and erect telephones for communication between the three offices. There is, however, a great deal more about telephone matters than seems at first sight. As the telephone's patents are likely to expire soon, I would advise you to make a set of receiving instruments, as described in No. 28 of Work, and a set of transmitters, same as given in "Shop" columns. I have not my back numbers, and cannot give the page, but you will be able to find it; it is in the centre column, and near the top of the page; the description includes little cones of carbon. You will want a switch-board to mount your instruments upon, and a call-bell. An article on this part of the subject is in the hands of the Editor, and may be published before you need it. You will also require a second switch for switching the instruments to the different sections of the line. I will give you these details when you need them. In the meantime, get your instruments made, and watch the paper for more information. Write again when you want anything, for I cannot take up more space at present.—W. D.

Paraffin Wax.—Querist.—The paraffin recommended for insulating the various parts of electrical apparatus is a white wax-like substance obtained from coal-tar and from rock oils. It is not the paraffin oil burned in lamps. It is easily melted in a stoneware vessel placed in a saucepan of boiling water, and the sheets of paper are to be dipped in the melted wax.—G. E. B.

Umbrella Pattern.—A. C. H. (*Kennington*).—At first sight it would seem that each of the usual eight segments of the cover of umbrellas would necessitate their being cut *curved* at the seams. This is not so, however, and for this reason the cloth, silk, or other fabric is cut "on the cross," as it is termed, at the seams, and this allows it to stretch to the curve of the ribs when bent; the "selvedge," as will be seen, is drawn up until it forms a curve instead of remaining straight to make up for the stretching. Therefore these segments consist of eight isosceles triangles, their bases forming the sides of an octagon, and their apex being the centre of a circumscribing circle. Hence, two such segments would together form a quarter of a circle; therefore the angle at the apex would be half a right angle—*i.e.*, 45°, and the two angles at the base would each be half of 135°—*i.e.*, a right angle and a half, because the sum of the angles in any triangle are equal to two right angles, or 67½° each. So long as these angles are correctly got, the length of the sides is immaterial; eight segments of a foot, yard, or mile at the seams will equally form an octagon, when placed in position, providing the angles of the apex are 45°, just as six segments would form a hexagon if their angles were 60° each, a pentagon if five segments of 72°, a septagon if the angles of each of seven segments at the apex were 51⅐ths°, or a

Fig. 1

decagon if similar angles were 36°. Construction of pattern therefore is as simple as possible. Let *a b c d* be a square sheet of brown paper (see Fig. 1), and, to ensure the size being correct, measure the rib of the umbrella frame from the hole at its point to the centre of the ferrule, by which it is attached to the stick, usually about 21 to 22 in., though some are 24 in. long. Make the sides of the square exactly of this length, whatever it may be. Now fold your brown paper square on the diagonal *b c*, the point *d* falling exactly upon *a*; then on the folded edge *b c* measure the length of *a b* at *e*; draw the line *a e* joining these points, and with the scissors cut out the segment *a b e*, which for clearness' sake I have shaded over. Having done this, you have a paper pattern to lay on your cloth, which to do so as to avoid waste, you should do as shown in Fig. 2, buying the covering material of the width that your paper pattern measures from the centre of *a e* to *b*, as shown by dotted line *a f* (Fig. 1). It may happen that you cannot get it so narrow in gingham; if so, get it double the width and cut it up the middle into two lengths, if you must use gingham. Silks are woven 21 to 21 in. wide. Lay your pattern on the stuff with *a e* on the selvedge, as shown in Fig. 2, and pin it down and cut out the material, leaving ¼ in. for turnings in at seams (see the dotted lines); then reverse your pattern, likewise laying it square on the other selvedge, about ¼ in. back from your last cut seam-edge, and cut that out also, with very sharp shears or scissors, so as not to fray the edge. Then turn your pattern to the first selvedge again, and proceed as before. Thus you will have cut the first segment *a e b*, the second *b e g*, the third *e g h*: then cut the fourth *g h i*, and so on till you have cut eight. By this plan you not only save waste of material, but you utilise the selvedge, saving the time and trouble of hemming, which is neither so strong nor so neat as the said selvedge. When the segments are all seamed neatly and firmly together, a complete octagon, perfectly flat, is the result. No hole is necessary (the stick should be forced through the centre); securely bind round it with strong waxed thread the ends of the various segments; this again cover with a bell-shaped ferrule. Now stitch with strong thread the selvedge ends of the seam to the holes at the end of each rib—with the frame unopened. Then stitch just below, and again just above the hinge in each rib, or "wire" the seam exactly over the rib to keep it in position. Carefully and gradually open the umbrella, when you will find that all the strains accommodate themselves to circumstances, and a good tight fit of the cover to the frame is the result. These remarks apply to the ordinary shapes of umbrellas; any difference in form or fashion must be specially provided for: such as the parasol shape, where an elegantly pointed shape is given. Though undoubtedly a necessary article in this climate, I never carried an umbrella in my life, not even a white sunshade in the tropics (except when escorting a lady), so that I cannot claim to be a connoisseur, regarding them as I do as a public nuisance—as public enemies to silk hats, to other people's eyes, and as roofs whose drippings filter uncomfortably down one's neck. When soaked with rain and folded in railway carriages and omnibuses, I think they ought to be charged with some tax, such as full fare, or be provided for outside in charge of the guard or conductor.—J. W. H.

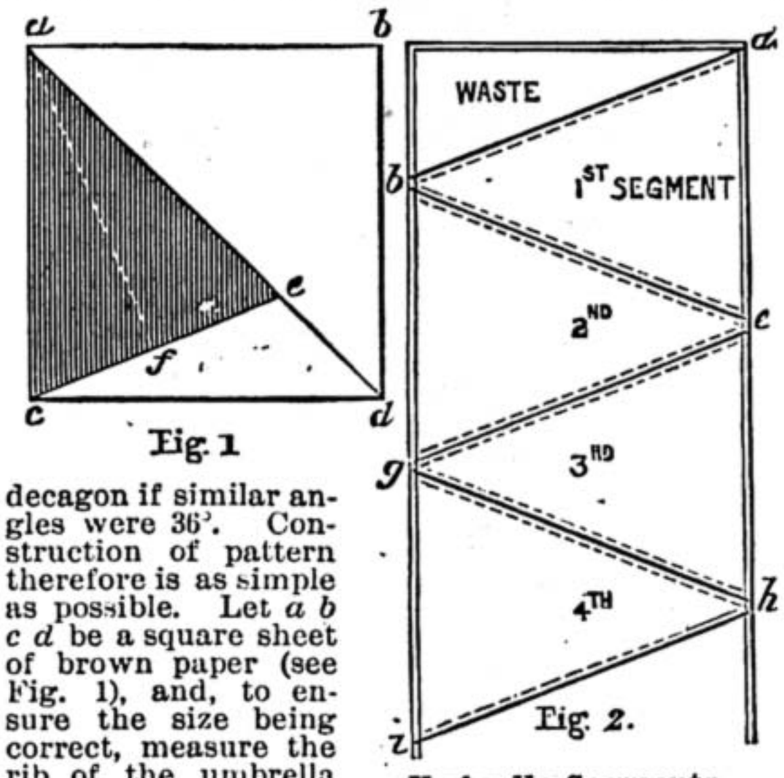

Fig. 2.

Umbrella Segments.

Lining.—Novice.—Do not use camel-hair pencils, but sable. The former may do for the very light colours such as ultramarine, the greens, drop black, etc.; but they are far too weak to carry vermilion, white lead, and the heavier colours. You may use oil colours, they have the advantage of flowing very freely, and do not clog the pencil like fast drying colour; but it is not always possible to finish a job without giving time for one portion of the work to dry without smudging it by your finger you use as a guide. Colour mixed with gold size and turps dries rapidly, and does not prevent the job being finished straight off, but the pencil requires frequent washing with turps or it soon gets clogged with colour. Care must also be taken or your lines will have a thin and bald appearance, and probably crack if turps is used too freely. Successful lining requires plenty of practice and great care of the pencils when not in use. Wash them very clean, grease them with a small portion of soft tallow, lay them very straight, and keep them free from dust; a bent pencil can only make a distorted line at any time.—Worker Bee.

Sizes of Holes in Soundboard of Organ.—W. P. (*Bedford*).—I think you will find the following answer very well on a 3 in. wind:—

	CC and 4 following holes.	Next 4 holes.	Following 4 holes up to Tenor C.
Cornopean	3/32"	4/32"	1/32"
Oboe	3/32"	4/32"	1/32"
Open	3/32"	4/32"	1/32"
Principal	3/32"	4/32"	1/32"
Voix Celeste	3/32"	4/32"	1/32"
Salcional	3/32"	4/32"	1/32"
Double	1 1/4"	4/32"	1/32"
Twelfth	1/32"	3/32"	1/32"
Fifteenth	1/32"	2/32"	1/32"
Mixture (3 ranks) ..	3/32"	2/32"	1/32"

As regards split pallets, as I have not made any myself, I scarcely feel competent to advise as to the quickest method of construction. There are several forms of relief pallets besides the one of which you send a sketch. I should think that the quickest way of making them would be to joint up a board cross-grain in usual way: plane to requisite width and thickness, and then, having marked the pallet widths from the soundboard, or from a rod, saw off the main pallets. Of course, the board is made the same width as the length of the pallets. Proceed in a similar way with the under pallet, and when these are shaped glue on each pallet a piece of the requisite thickness to fill in the space at the end, as at A in sketch.—M. W.

Speed of Dynamo.—M. P. S. (*Kingstown*).—If you have a 1-in. pulley on the spindle of your dynamo, and drive it from a 30-in. pulley, you will have to turn the crank handle at the rate of 100 revolutions per minute to develop a speed of 3,000 revolutions per minute in the armature of the machine. This is the speed necessary for small five or six-light dynamos. The six lamps will take 120 watts of electric energy to light them properly, and this will absorb one-sixth of a horse-power, representing roughly one man-power. You will find, however, that it will seriously tax the strength of a strong man to keep even 5 c.p. lamps alight for any length of time. The 40-in. fly-wheel will certainly help to keep the speed regular, and this is most important in electric lighting; but you won't get any more power out of the fly-wheel than you put into it.—G. E. B.

Electro-Gilding.—Little Joe.—We have not yet published any articles on electro-gilding, or electro-plating with silver or with nickel, but some are in course of preparation. An article on "Electro-Brassing" was published in the weekly number for December 7, 1889, and one on "Taking Electrotype Copies of Busts" in the weekly number for August 9, 1890. Various scraps of information on the electro-deposition of metals, in reply to the questions of correspondents, may be found in "Shop" throughout both volumes of Work.—G. E. B.—[The price for each single back number is one penny, if ordered through a bookseller, or three halfpence per number if sent by post direct from the publishers.]

Electric Alarm Clock.—J. H. C. (*Halifax*).—I do not know of a book on electric alarm clocks showing "various ways of connecting the wires to the electric bells." An article on "How to Make an Electric Alarum" was given in No. 32, Vol. I. of Work. There has been much information published in "Shop" on this subject since that date, as you will find by consulting the Index to Vol. I. Why do you seek a book on the subject when you have Work, wherein our services can be placed at your disposal for the modest cost to you of a few pence?—G. E. B.

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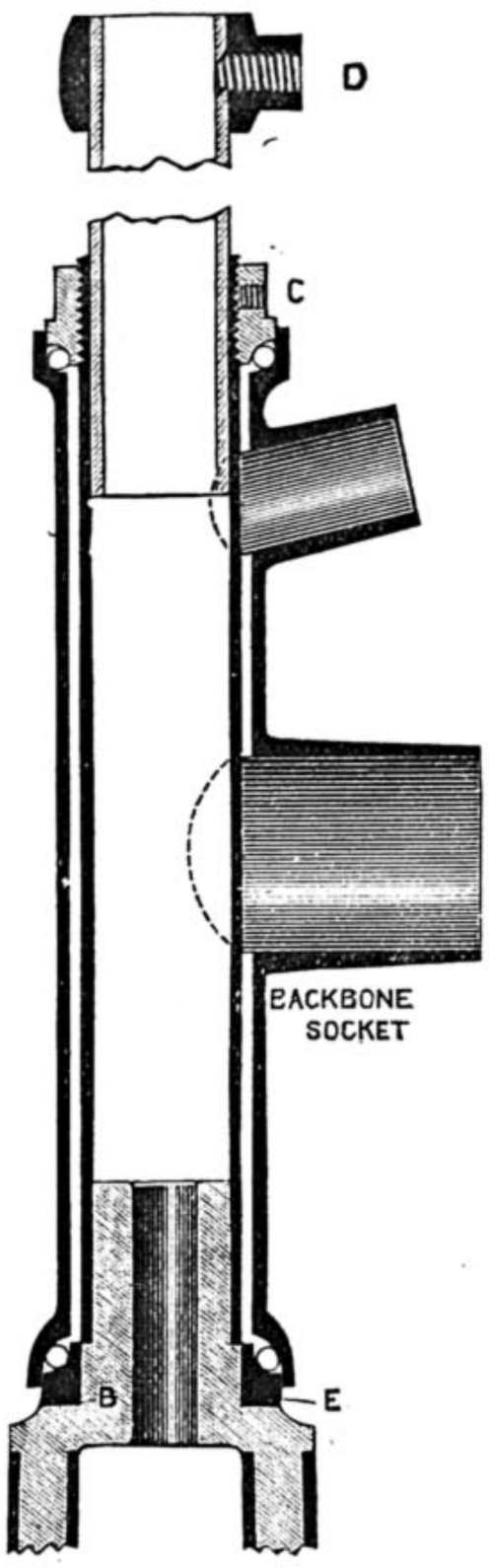
Safety Bicycle.—J. H. D. (*Luton*).—Unless J. H. D. is a mechanic, he aims at too much. A ball steering head safety is about the highest class of machine, and requires pretty accurate work to make it, besides some knowledge of the case-hardening process. I enclose sketch of the ball steering head as I make it. It is a section of the barrel with the backbone socket and upper tube socket attached; it is a malleable casting. The ends are turned to fit the balls; B is the front fork crown; it has 6½ in. of 1-in. tube attached. This passes up ½ in. above the barrel, and is screwed for the adjustment collar C. Inside the 1-in. tube is 6 in. of ⅞-in. tube, with clutch D at top for handle bar. The fork crown B is a malleable casting with a ½ in. hole bored up the centre to lighten it or to fit a concealed brake, the plunger rod passing up inside the tube to the handle bar. The ring E, on which the lower balls rest, has got to be case-hardened, as also the adjustment ring, with both ends of the barrel, where the balls run. The ⅞-in. tube passes inside the 1-in. tube about 1½ in., and is there brazed, the 1-in. tube being also brazed to fork crown; balls, $\frac{3}{16}$ in. With regard to springs, I suppose J. H. D. means a spring frame. There are several patents for spring frames in the market, and he will have to keep clear of them; some have the front wheel only fitted with a spring, others have both. J. H. D. had better indicate his ideas of a spring frame; if he has none, I should advise him to build a rigid diamond frame of a good pattern. (2) As to the gauge of tubes for a diamond frame, the main tube from steering head to bottom bracket is 1¼ in. in diameter, 16 B.W.G. Top tube from steering head to seat pillar socket, ⅝ in., 18 B.W.G. Two tubes from seat pillar socket to rear axle, ¾ in., 18 B.W.G. Two tubes from rear axle to bottom bracket, ⅝ in., 18 B.W.G. Tubes on the gearing post (see sketch), 18 B.W.G.; piece attached to handle bar, ¾ in., by 16 B.W.G. The ball steering arrangement shown in sketch is not for diamond frame, but for semi-diamond.—A. S. P.



Bicycle Ball Steering Head.

Wedding-Ring Making.—INDEX.—Why do you not repeat your question when you write? If it has not yet appeared, it doubtless awaits its turn in the overcrowded columns of "Shop."

Greenhouse Construction.—L. W. R. (*Enfield*).—If you purchase the Index to WORK, Vol. I.—it costs one penny—you will find several references to greenhouse matters. A paper on the subject, with illustrations, appeared in WORK, No. 12. It is entitled, "The Tenant's Greenhouse."

"Shop" and WORK Contents.—G. R. R. (*West Calder*).—Whatever delay there now is in the appearance of answers in "Shop" is unavoidable. Steps are being taken to appreciably shorten all future answers, and this will create room for many answers standing over only through want of space. The contents of each week's number rests solely with the Editor of WORK, who may be presumed to be a better judge than any individual subscriber can possibly be of what best suits the tastes of his whole constituency of readers.

Polytechnic Paper Scales.—NEMO.—There is no such scale as you refer to.

Polish.—HANDYMAN.—The Editor has an article in hand on repairing old furniture, which answers your question fully. Look out for it. Burnt sienna ground in oil forms paint, and, so far as I am aware, is not generally used by polishers.—D. D.

Waxing Floors.—WAX.—Finishing floors with wax and varnish will be treated later on. Meanwhile, use brown oak varnish or any similar one.—D. D.

III.—QUESTIONS SUBMITTED TO CORRESPONDENTS.

Painting Flowers.—J. E. H. (*Southampton*) asks for a hint or two about painting flowers, etc., on terra-cotta plates, etc.; can he do it with ordinary tube colours (oil) or water colours? If the latter, what can he make the colours shine with?

Small Fire Fan.—T. S. (*Caldmore*) writes:—"Will some kind reader give me the necessary instructions (and working drawings, if I am not asking too much) to enable me to make a small fan to blow the fire with in the mornings, to save time; also say where I could buy the castings?"

Glass Cement.—O. H. O. (*East Dulwich*) writes:—"Will any reader kindly inform me of the best mode in cementing a glass bowl to a metal body of a paraffin lamp, and how to prepare, or where to obtain the cement?"

Prices for Sawing.—E. E. W. (*Bushey*) writes:—"Can any reader inform me how to charge for work done by band and circular saws? I may say the work will consist of all kinds of sawing for builders' yard, wheelwrights, and coach-builders. Also staves for coopers (both doublets and straight cuts)."

Cutlery, Clock Dials, and Pearl.—F. F. F. writes:—"Sheffield cutlers have a method of printing on ivory, I *think*, with caustic or nitrate of silver from engraved plates. How is it done? and in what form is the caustic or nitrate of silver used? Is it possible in any degree to soften or destroy the brittleness of pearl? With what do they paint the figures of clock dials?"

Bristles.—F. E. J. (*London, S.E.*) writes:—"Will someone tell me how to twist the wire and put in the hair, or bristles, or whatever name the material goes by, of bottle brushes or jug brushes and lamp-glass brushes? If twisted by hand, what tools are required? and if by machine, what machine is required. Are the bristles put in by weight? What inches in length to suit each size of brush? If you will kindly help me, you will do me a favour. You see, what I want is to learn how to make those kind of brushes, as it will help me to get a living."

Blackboard.—F. T. (*London, N.*) writes:—"Will any reader inform me how to prepare and what stain to use for a blackboard, as I want to make one?"

Drain Pipes for Decorating.—G. (*Burnley*) writes:—"I should be greatly obliged if any reader would tell me where I could get some smooth drain pipes for decorating upon. I can get the ordinary ones at Burnley, but they are too rough and crooked for my purpose."

Violin Mute.—VIOLIN writes:—"It will greatly oblige if any of the readers of WORK would kindly give me instructions how to make a mute for the violin."

Cork.—G. B. (*Poplar, E.*).—"Would any reader of WORK kindly inform me through 'Shop' where I can get cork wholesale for making life-belts?"

Boot Making.—THE LAST THAT SHALL BE FIRST writes:—"Would M. G. kindly instruct me, through the medium of 'Shop' (say, in two or three stages), how to make a pair of boots (one stage each week); first to the fixing on of the uppers, to the sewing on of the welts, and so on to the finish? I have read his article headed M. M., but do not fully understand it all: the quality of leather for insole, welts, sole, how to fasten the uppers to last and sewing process, what he means by shanked, skived, seats, and lifts, or split lifts; the distance to sew from edge of upper, and where to begin; and I cannot see what he means by putting the heelawl through each stitch on upper side, and taking up stitch when sewing through sole and lifts—in fact, every particular and detail."

IV.—QUESTIONS ANSWERED BY CORRESPONDENTS.

Picture Mouldings.—LINENO writes, in reply to H. R. (*Bacup*) (see page 506, Vol. II.):—"These can be procured at several places in Miller's Lane, Manchester."

Cost of Mandrels.—LOCO writes, in reply to J. T. (*Walworth*) (see pages 159 and 455, WORK, Vol. II.):—"If J. T. is still in want of a mandrel, I should be glad to make him one as described in my spare time, for 10s. 6d., or any other small work in fitting or turning."—[Why not follow the example of others, and keep your address before our readers in the "Sale and Exchange" column?]

Circular Saws.—F. J. G. (*London, W.*) writes, in answer to H. G. (*Little Bolton*) (see page 552, Vol. II.):—"The best book published on circular saws is 'Saw Mills: Their Arrangement and Management,' by M. Powis-Bale, published by Crosby Lockwood & Co."

V.—BRIEF ACKNOWLEDGMENTS.

Questions have been received from the following correspondents, and answers only await space in SHOP, upon which there is great pressure:—S. T. · H. C. (*Nelson*); A CONSTANT READER; YUTICAN; G. P. (*Elgin*); F. M. R. (*London, E.C.*); BRICKLAYER; J. McI. (*Glasgow*); J. McG. (*Leith*); A. T. B. (*Bromley*); S. T. R. (*Gloucester*); NO FAD; G. H. (*London, E.C.*); J. W. B. (*Huddersfield*); D. McD. (*Camberwell*); N. H. (*Dartmouth*); PUZZLED; MAGIC LANTERN; W. M. C. (*Glasgow*); OVERMANTEL; SAW; A READER OF YOUR VALUABLE PAPER; J. M. (*Stafford*); T. G. S. (*Surrey*); A. K. H. (*Bridport*); W. J. T. (*Westmoreland*); G. H. B.; H. D. (*Suffolk*); J. T. (*Hull*); S. A. L. (*Derby*); T. W. (*Burnley*); SWANSEA; FITTER; J. S. (*London, N.*); W. J. W. (*Monkwearmouth*); H. W. (*Gateshead*); W. C. P. (*Warwick*); J. C. K. (*London, N.W.*); H. A. (*Ellesmere*); J. L. (*Wimborne*); D. P. P. (*Sheffield*); W. O. (*Wrexham*); W. A. W. (*Stockport*); REFLECTOR; NEW READER; W. S.; F. K. B. (*London, E.*); HEN; CONSTANT READER; A. B. A. (*Nottingham*); MIEUX QUE ÇA; W. D. (*Tetsworth*).

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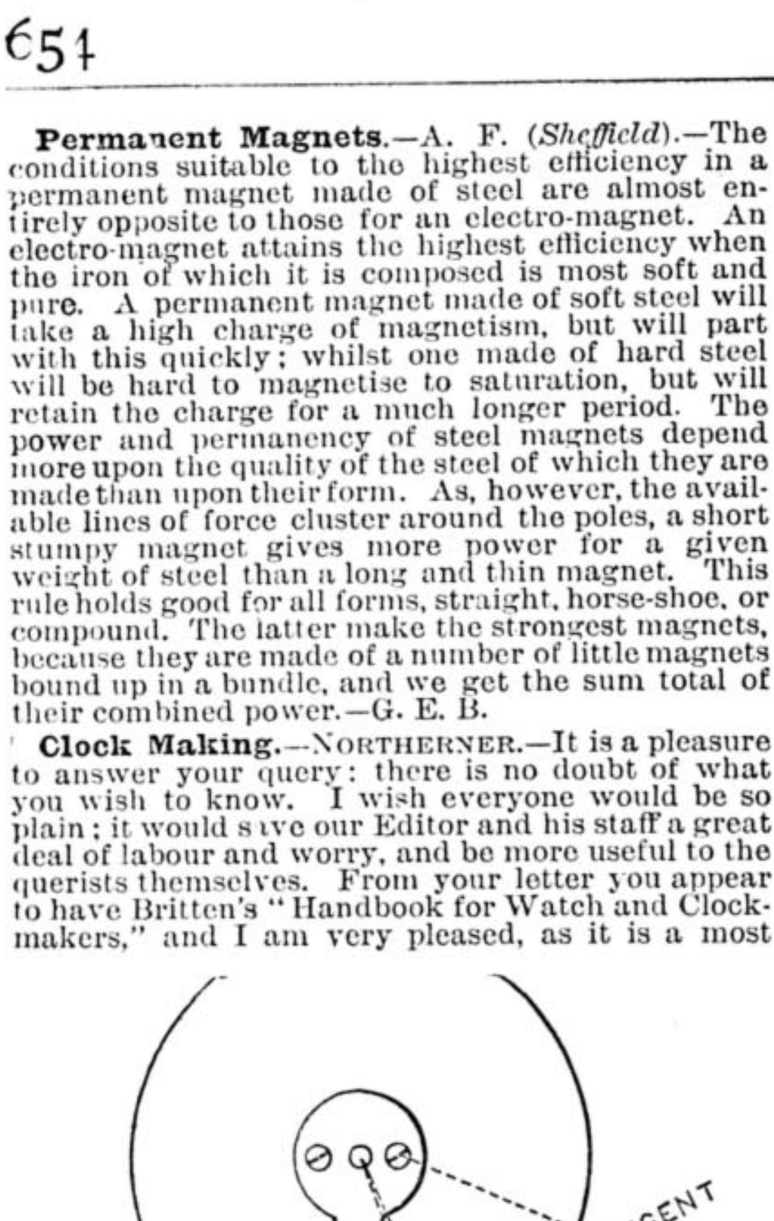
Permanent Magnets.—A. F. (*Sheffield*).—The conditions suitable to the highest efficiency in a permanent magnet made of steel are almost entirely opposite to those for an electro-magnet. An electro-magnet attains the highest efficiency when the iron of which it is composed is most soft and pure. A permanent magnet made of soft steel will take a high charge of magnetism, but will part with this quickly; whilst one made of hard steel will be hard to magnetise to saturation, but will retain the charge for a much longer period. The power and permanency of steel magnets depend more upon the quality of the steel of which they are made than upon their form. As, however, the available lines of force cluster around the poles, a short stumpy magnet gives more power for a given weight of steel than a long and thin magnet. This rule holds good for all forms, straight, horse-shoe, or compound. The latter make the strongest magnets, because they are made of a number of little magnets bound up in a bundle, and we get the sum total of their combined power.—G. E. B.

Clock Making.—NORTHERNER.—It is a pleasure to answer your query: there is no doubt of what you wish to know. I wish everyone would be so plain; it would save our Editor and his staff a great deal of labour and worry, and be more useful to the querists themselves. From your letter you appear to have Britten's "Handbook for Watch and Clockmakers," and I am very pleased, as it is a most

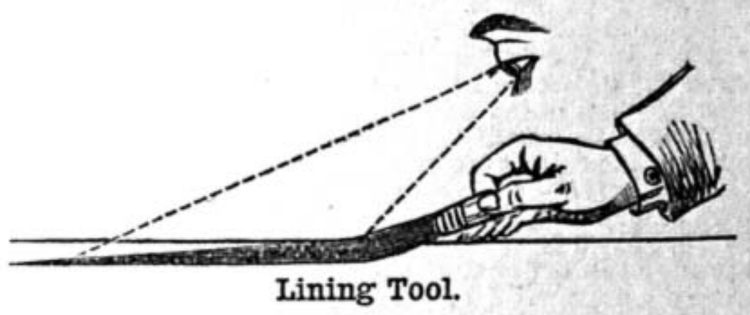


Clock Making.

Rough Sketch of Escapement, the Centres of 'Scape Wheel and Pallets being out of the usual Proportion.

useful book to anyone, amateur or otherwise, I think. Now to draw your pallets: proceed exactly as he says on page 9, *excepting that you mark the exact distance of your centres of 'scape wheel and pallets, and work from that instead of the distance he gives, viz.*, radius of 'scape wheel by 1·4 (of course in new work you would use his measurements). Having done that, you will find that the leading pallet, marked E in sketch, would come out all right; but pallet F would be nothing, or next to it. Now, having drawn the impulse line A, mark off four degrees inside, as dotted line B; next draw radial line D from centre of 'scape wheel through the tangent line G, where it crosses the impulse line B. You will now find you have a good pallet at F equal to the one at E. I trust, from the above and the rough sketch enclosed, you will understand my meaning. Some years ago I encountered the very same thing as you, and was completely fogged how to proceed until a friend, who is a great authority on horology, instructed me as above, and since then, whenever I require to make pallets for *jobbing purposes*, I have followed this rule, always with the best results, always using the distances of the depth on the plates instead of the measurement 1·4 of the radius of 'scape wheel. Allow me to also give a hint: make all these drawings on a piece of zinc, and cut out the pallets as drawn; fit them on the verge, and test them; alter, if necessary, till they escape all right, and make your pallets from it. I find that the easiest way, and best in the end, for if spoilt it is easy to make another, time and material being nearly nil. Now I shall take it as a favour if you will communicate the result—in fact, if all would do that we should know better how to assist others, or whether our advice and instructions were intelligible or not, as sometimes I may forget I am telling one who has not the experience of one who has learnt the trade. You wish also for hints as to shaping and tempering; I always, or nearly so, draw the lines H and I from the centre of scape wheel; the other parts, I think, are merely a matter of taste; but as to the acting faces, round them, as Britten says, and the better they are polished of course the better for the clock. As regards tempering, I always make just the pallets (E and F only) very hard, and leave them so. As regards the castings, etc., for a clock, you cannot do better than send to J. Mayes, 55, Red Lion Street, Clerkenwell, E.C. I can confidently recommend him, as I have had a great number from him; write and say what you require, enclose addressed and stamped envelope, and I feel certain you will get it; the price I cannot say, not at present being able to put my hand on any accounts. I shall be pleased, indeed, to give any further information on this, or any other, job, either in WORK or privately through the post; in case of urgency, the Editor will forward any letter no doubt; we all owe him our best thanks. I have learnt many things from WORK, and trust others have done so.—A. B. C.

Fine-Lining 'Bus Panels. NOVICE.—The failure to draw a straight line with a pencil and colour may result from unsteady nerves, defective vision, fumbling manner of holding the pencil, or faulty positions of the guiding fingers, etc. Or the colour may be badly mixed, the ground-colour surface not rightly prepared to receive the line-colour, or the "lay" of the pencil and starting at each dip of colour may make a gouty line. You must cultivate a faculty—*i.e.*, "deliberation." The first thing you have to do is to study such positions of work in relation to the horizontal level as will train the eye, fingers, pose of body to the many possible positions of a painter at work. The first lesson I once gave a youth was with the microscope—the object lesson: single hairs of different animals, including camel, sable, fitch, lynx, ox, hogs' bristles, etc.; he learned the peculiar formation of different hair, and the overlapping scales which cover them, and that it is these scales which hold the colour, and yield it under pressure by the law of adhesive attraction—not capillary attraction in this instance. This was to teach an impatient youth *deliberation*. Follow for yourself this method. Now for technique and science of manipulation and colouring, which terms are to be rendered by the homely words "touch" and "sense." The panel must have been flatted down with fine pumice-dust to a dull egg-shell dimness of surface: this is essential. Now bear in mind that you should be able to use the left and right hands equally well; if you cannot, put the left hand to do a lot of easy short lines; for to be a painter, the left hand must be taught up to the right-hand mark. Next, as a learner, mark the line at the right distance from the moulding: this is by a pair of compasses, wash-leather on one point, and a finely pointed piece of charcoal, chalk, or suitable soft substance, on the other. This will give you confidence that you are going straight; once you have that confidence, you will never want to use these mechanical aids for your judgment. The 'bus body is usually tilted up to an angle of about 45°; it is not fair to a learner to expect him to lay a line of colour on a vertical panel: that can be done with practice, and has to be done on surfaces horizontal above the painter's position. The moulding of the framing of the body guides the hand by those fingers of the hand not holding the pencil, using the moulding as a gauge-guide; the thumb and finger hold the pencil, the other fingers are kept rigid, but without any strain, and the pencil is drawn along the line with a graduated pace, slightly quicker at first, while the colour flows freely and slower at last, to enable the smaller supply of paint to escape from the hair, in which it is aided by the adhesion of colour drawing it from the pencil, as well as by pencil-pressure on the panel. I asked an expert and prize-winner of painting of the Polytechnic Institution to supplement my remarks by his experience, which he did. Charles Witham, the writer of the following, is a most efficient teacher, if one be wanted by a learner:—"It requires a steady hand, and the hand must be guided by the eye, as shown in sketch. The eye is first directed to the point of the pencil; when that touches, the eye should follow to the butt or the heel of the



Lining Tool.

pencil, and there rest until the line is finished. Confidence is a great thing in all pencil-work, which is obtained only by practice; when you lay the point of the pencil down and spread it out to the required width, which is done by the movement of the fingers as you lay the pencil level to draw, without stopping at a graduated pace, in drawing the pencil along unevenly it will cause the colour to flow more in some parts than others, thus making an uneven width in the line. When your pencil becomes empty, you must re-dip in the colour, then work it on the palette until the hairs of the pencil are even and straight: then you will not get too much colour in the pencil. As the colour becomes thick in the butt or heel of the pencil you must dip it in a little turps, which you have in a 'dipper' by you while you are at work, and work on the palette as before. If you were to use the pencil direct from the pot of colour on to the panel or spoke, you would get too much colour, and it would run all over the surface, and spoil the line. When you have re-filled the pencil to continue your line, do not start from the exact point at which you left off, but start a little way back on the line, or else the connecting line will be smaller and uneven in colour, unless thus retraced, the paint being less in quantity towards the last 'lay off,' and it will not cover the ground colour solidly. On 'busses, as a rule, it is the mouldings that are picked out gold, black, etc., with ⅛ or ¼ line of another colour on the edges, or sometimes ½ in. away from the moulding on the panel; but the distance may be as much as 4 in. from the moulding, the little finger forming the gauge-guide of the hand. Success is progressive; do not attempt a line 8 ft. long till you can do one a foot long well; now and then practise on old panels, short lengths, and vary the straight line with curves, which are more difficult." Varieties of pencils for lining and striping, or bands, are made of sable, camel's-hair, Siberian ox-hair, etc.; the best are sable, of which there are two kinds, the red and the black, either of these will make good stripes, but the red hair is mostly used for ornamenting panels. Camel's-hair is softer, but does not do for heavy colours, such as vermilion; the sable ox-hair is the best for heavy colours; the camel's-hair is best for blacks, chromes, or whites; this hair being softer, it holds more colour, and levels better. One word, not about painting, but essential to success—cleanliness of shop, tools, and person; a clean painter commands ready work, and keeps his place and health; a dirty painter risks losing both.—J. C. K.

Small Tubes or Sockets, etc.—X. Y.—I cannot advise you how to make a machine to turn and punch the sockets you require. I should think that the best thing you could do would be to get one of Rhodes' small tube bending rollers, of which I send you a sketch (Fig. 1), from which, if you like to try and make one, you can. For my own part, I should not punch them at all, but should draw the rivets through with the rivet set. To make the pattern for the dish-shaped article, proceed as follows:—Set your compasses at 13 in. on a piece of tin, zinc, or paper; strike out an arc of a circle 14 in. or 15 in. long. Set your compasses 3½ in. smaller, and describe another arc (see Fig. 2). On the top line set two points, A and B, 12½ in. apart, and from these points draw lines toward the centre C; the figure contained within A, B, D, E will be the pattern you require; allow ¾ in. each side for the seam. Now as to working it up: the reason it cracks as you turn the edges is, I expect, because you draw it over too suddenly, and do not humour the stuff enough, or else you have bad tin. I should advise you to wire the small part before turning round, then work the gold for wiring the top (Fig. 2) very gradually, using first a flat tool and a broad pane hammer, and stretching the stuff a little on the outside edge, then finish on the half moon stake; if this fails, then wire both top and bottom before turning. To make your hatchet copper bit you must work it at a cherry-red heat, and to make the nick round it, as shown in your sketch, use a bottom tool and fuller, and get someone to strike for you; draw down the hatchet part last.—R. A.

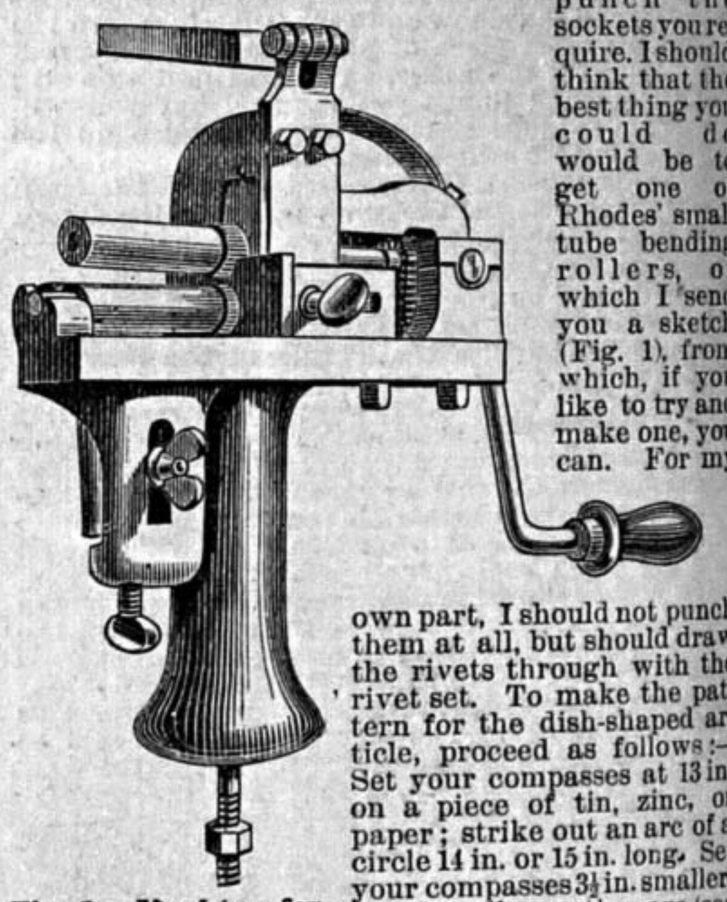


Fig. 1.—Machine for forming or bending Small Tubes or Cylinders, with or without Bead, 6 in. long, 1 in. and upwards in Diameter.

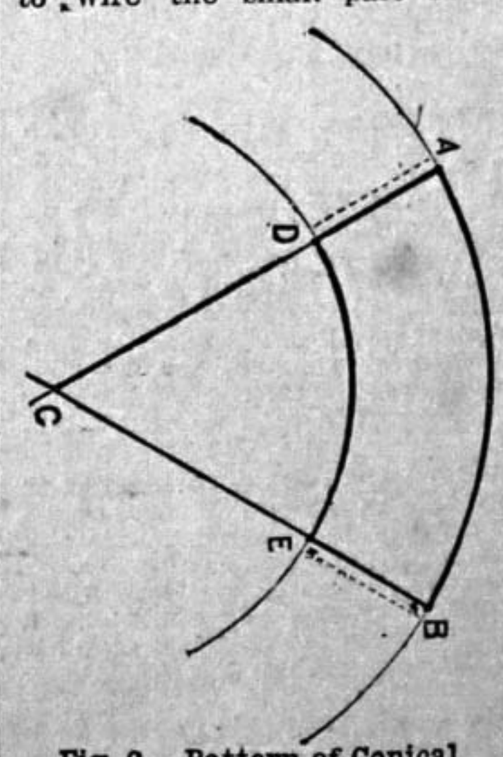


Fig. 2.—Pattern of Conical Article.

American Organ Fittings.—AMATEUR.—For all parts of these instruments, for own building, you will do well to apply to the American Organ Fittings Co., 2, Oseney Crescent, Camden Road, N.W. Papers on the subject are in hand, and will probably appear in Vol. III.

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Model Yacht.—E. O'N. (*No address*).—In making "a model yacht for match sailing," work your boat out of the solid. Don't attempt to build a model yacht with frames and timbers and planks, but obtain a good sound block of yellow pine, dry, and free from knots and shakes. This procure from any large timber dealer or saw-mill, at a cost of a few shillings. For a 36-in. boat, a piece will be required, say, 40 in. long by 12 in. wide by 9 in. deep. This length allows 4 in. for the overhang of counter, and will allow of the boat being 36 in. on the water-line. The depth given is for the boat without keel, and as the keel must be of lead, there is no use making one of wood, which would only have to be cut away afterwards; but as you might find a wood keel of assistance while working out the model, you had better commence with the dimensions given, and nail on a false keel, formed out of a strip of wood 36 in. long by, say, 2 in. wide, and 4 in. deep at one end, tapering off to 1 in. at the other. The only tools required are plane, gouge (a long gouge ground on the inside is the best), spokeshave, square, and sand-paper, and an axe, a mallet, and brace, with large centre-bit. First draw straight lines along the top, bottom, and ends of the block, dividing down the middle on its 12 in. surfaces. These lines represent the keel on the under side, the stem and stern posts respectively at the ends, and the centre line along the top side, or deck, and they should be carefully preserved throughout the entire operations (see Fig. 1). Then with a thin strip of wood, whalebone, or other flexible material, mark out the deck plan, leaving the stern, say, 8 in. wide, as in Fig. 2, and cut down the wood to these lines, keeping the sides square to the top, or deck, for the present, and you will have a figure somewhat coffin-shaped in appearance. The rest of the work outside will be done with the block upside down, so turn it over on the bench, and with gouge and mallet (or up-ended on the floor with the axe) rough out to the shape desired, and finish off with spokeshave and sand-paper until all is quite fair and smooth, taking every possible pains to get both sides of the boat exactly alike; and for this purpose, if necessary, cut out templates of cardboard, or bend strips of sheet lead, and try them repeatedly. The false keel above mentioned is given as 4 in. deep at one end, and this is for the stern, as this end of the boat must be considerably deeper than the bow, or she will not steer properly. Next proceed to hollow out the inside, and, if a cautious man, you will find the brace and large centre-bit of great assistance, finishing off with gouge and sand-paper. Don't be so rash as to go through anywhere, but leave a skin or shell of about ½ in. thick, making the lower part and round the top edges a little thicker—the former to sustain the weight of the heavy lead keel, and the latter to support the deck and fastenings, so that the section will be something like Fig. 3. For match sailing, bulwarks are encumbrances only, so do not attempt them, but cut away the sides of the model slightly for sheer, as dotted line in Fig. 4. The keel now requires attention, and for this purpose a pattern must be made in wood. Nothing could be better than the false keel before mentioned, which should be removed from the boat, and pressed into a bed of clay tolerably dry, or into a box of sand slightly damped. It is no easy matter to bore holes through a thick piece of lead, so it is as well to provide for the holes necessary for fastenings during the casting process. Therefore, get a number of short straight wires, say eight or nine, and 6 in. long and ⅛ in. or 5/32 in. thick, and fix them vertically down the centre of the mould, having first coated them over with a soft paste made of clay and water, so that they will draw out of the lead when cast. Do not let your sand or clay be too wet, or the molten lead will sputter, and in pouring in the metal keep your face turned away to prevent accidents. When the lead is cold it will be found an easy matter to hammer out the wires, and the holes for fastening to the boat are ready made. The keel will be rough and require getting up, but a rasp and hammer will soon set this right, and some long French wire nails will suffice to attach the keel to the boat, and make all secure. Next put on the deck, which for racing models should be laid on over the top of the gunwales, and not let in; but first fit in a deck beam, slightly rounded on its upper side, to support the mast. Make the deck of yellow pine, quite thin, say ¼ in., and fasten down all round with stout pins or thin French nails, and varnish and paint according to taste. The much vaunted enamels are perhaps the easiest method of obtaining a good surface; but the best plan is to use ordinary paint—two or three coats laid on very thin, and rubbed down when thoroughly dry with pumice-stone and water, and then varnished with copal or French polished. As to the rig of the yacht, the cutter will be found to have the greatest speed, and if this rig is selected it is a safe rule to make the mast, bowsprit, and boom the same length as the boat—i.e., 36 in. long; the gaff should be three-fourths the length of the beam, and the topmast and topsail yard about the same length. In giving this rule, it must be remembered that the measurements will be for length of spars outboard, so that in the case of the bowsprit, if it has to be 6 in. inboard along the deck, the whole length of bowsprit will be 42 in. The mast and bowsprit at the thickest parts should be ¾ in., tapering off to ¼ in. at their outer ends, the boom slightly thinner (the thick end of the boom is placed outwards over the stern), and the gaff thinner still. Yellow pine is the best wood for the spars, though pitch pine is much tougher, and looks better if the extra weight is not objected to. They can be made with the plane, and should be sand-papered thoroughly smooth, and then varnished. The reader will, no doubt, have seen that the model yacht for racing is a very different boat in many ways to the miniature or model yacht in the strict sense of the term, and in the rigging this difference will be made more apparent, as, in the case of the racing model, handiness of gear has to be looked upon from the standpoint of the sailor outside the boat. The mast should not be put through the deck, but should be let into a brass socket or wooden chock (made of hard wood) screwed on the deck. This should be placed about one-third of the length from forward, and can easily be moved, if required, in trying the sailing qualities of the boat later on. Another advantage of this plan is that the boat has no apertures through which the water can gain access to the inside. At the thin end of the mast

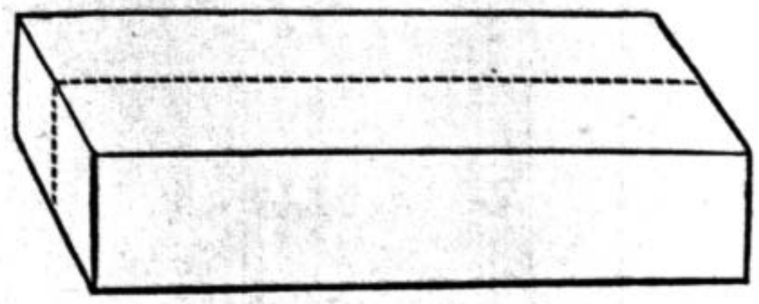

Fig. 1.

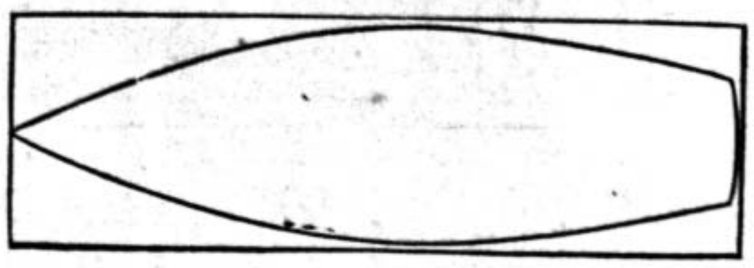

Fig. 2.

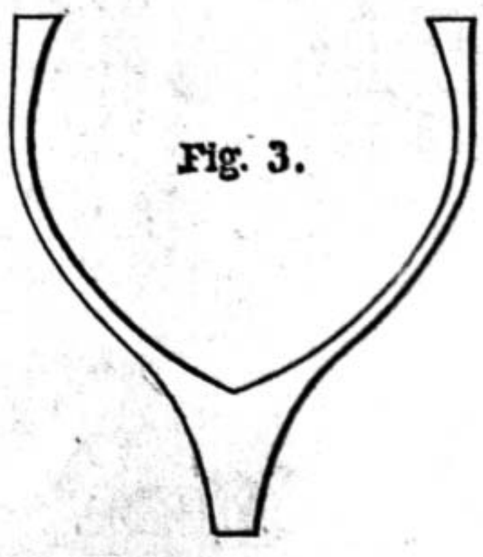

Fig. 3.

fit on a brass ferrule or fishing-rod joint, into which the topmast should slide, and on this ferrule a number of small brass rings (obtained at any fishing-tackle shop) should be lashed with fine, but strong, linen thread or silk, and varnished. These are for blocks for the running gear, and are placed in position like eye-bolts in large yachts. The mast

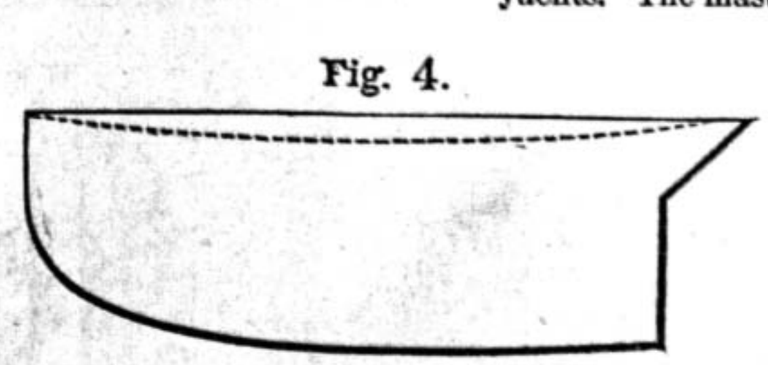

Fig. 4.

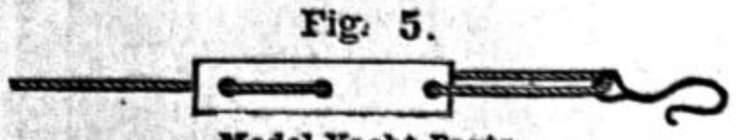

Fig. 5.

Model Yacht Parts.

should have a stay or shroud on each side attached to the eyes on the ferrule at masthead, and leading down to deck, and there secured, one on each gunwale, to eyebolts or screwed eyes, like those used on the backs of picture-frames. The forestay must, in like manner, be secured from masthead, and would, in the ordinary course, be made fast to the sternhead, but for a racing model a larger foresail can be carried, if the stay be brought out on the bowsprit, and there secured, about one-third of its length outboard. All these stays should be of good stout fishing-line or whipcord. The bowsprit should pass through an eyebolt screwed into the deck near the stem, and the heel of the bowsprit tapered a good deal, and let into another eyebolt screwed into the deck near the mast; but this eyebolt must be so much smaller that the bowsprit will not slip through it; a shroud at each side of the bowsprit, and a bobstay underneath it, must be fitted, like the shrouds and stay, to the mast, fixing small eyebolts into the sides of the boat near the mast shrouds, and in the stern near the water-line for the purpose. It is often desirable to unship the mast and bowsprit when transporting the boat, and therefore the shrouds and stays should be made with hooks, so as to be readily removed, and yet when in use it is necessary for them to be kept tight. The most usual contrivance for this purpose is similar to that commonly seen on tennis nets, and for model yachts should be made of thin bone or brass, and are like Fig. 5. This device will be found very useful, and may be applied with advantage to almost every rope on the ship. The boom should be attached to the lower part of the mast by what is called a goose-neck—*i.e.*, a joint that will work every way; and the most easily constructed is one made of two pieces of brass wire with an eye turned in at each end and one eye hooked into the other. Bend one wire round the mast (or go through it if there is plenty of strength in the mast), and insert the other wire into the thin end of the boom, whipping the end round with stout linen thread, to keep it from splitting. The gaff should slide on the mast by means of jaws, and these are best made with a piece of brass wire bent, with a loop in the middle the size of the mast's diameter (a slack fit), and the ends lashed tightly to the thick end of the gaff with linen thread. Lash three eyes or small rings on the upper side of the gaff for hoisting, one close to the jaws, one in the middle of the gaff, and the other about three-fourths of its length out, and the gaff is complete. The sails are four in number—mainsail, foresail or staysail, jib, and topsail, and by many it is considered necessary to have two or more sizes ready for use in any state of weather. The sails should be made of thin calico, closely woven, and smooth on the surface. The great aim in making sails is to get them to stand flat, and not to let them "belly" like a saucer. With this end in view, let the after side of every sail be a selvedge, and do not hem it on that side. Cut out all the sails first in paper (making them rounded a little on the foot), and then cut the calico from the paper patterns, allowing cloth to turn in for the hems. The sails can be sewn well enough in the sewing-machine, but every precaution must be taken against stretching any side of them which is cut on the cross, or they will be ruined. The jib and foresail may be attached to booms if thought fit, but do not lace any of the sails to booms along the foot. Copper wire travellers should be fixed to the boat for the mainsail and foresail sheets to travel on, and the traveller for the jib is conveniently placed across the bowsprit. The mainsheet is easily worked by the bone or brass clip before described for tightening any of the ropes, or by means of a stout brass pin with an eye in one end, to which the mainsheet is attached and led through a hole in the boom near the stern, whence it leads to the traveller. A number of holes are then bored along the boom, into which the pin can be fixed, and the length of the sheet regulated according to the direction the boat is to be sailed. A word in conclusion as to steering. Of course, as the boat carries no crew, she must steer herself, and this is done by the sails entirely, except when running full before the wind, in which case a heavy leaden rudder must be slung on the stern-post, and allowed to swivel freely on its bearings; and two or three rudders should be provided of different weights for this purpose. Sailing against the wind, however, is most practised, and it should be understood that this is done without any rudder. The mainsail is the principal driving sail, but would, if left to itself, quickly send the boat up into the teeth of the wind. The jib, therefore, is kept in pretty tight, so as to counteract the effect of the mainsail in this respect; and if the sails are not very well balanced, the boat will be continually running up into the wind and paying off again, and a little practice will be necessary to overcome this difficulty, and obtain a nice even balance; but with a little patience this can be done to a nicety. With this in view, the boat is made to draw much less water forward than aft, and the fore-port should be well rounded up, so that the bowsprit does not need to be so very long, and the sails are more compact. A light bamboo rod with brass boat-hook or window-hook at the end for turning the boat completes the outfit, with the addition, perhaps, of a few small shot-bags for assistance in steering.—W. H. M.

Rigging Model Yacht.—J. T. S. (*Tamworth*).—To rig your schooner yacht for racing, you will find sufficient directions in answer to E. O'N. above; but give your boat two masts instead of one. If you desire to rig your boat as a complete model of a large yacht, then write again.—W. H. M.

Earning Money with the Lathe.—COMPO.—You wish to augment your income by turning at home, and you wish for advice as to how you may obtain a quick return with little outlay. You do not say you know how to use a lathe—indeed, I gather you do not; you "dabble" in fretwork, but think it impossible to add to your income in that way. Also you wish to know where a lathe may be bought. I think you could best buy a lathe by advertisement, watching for a good opportunity. I once got a good lathe for a workman friend for £2, which I think very cheap. I think you could not reasonably expect to turn anything you could sell till you have had six months' practice; what would you think of a man who set out to be a "comp." in that time? It is useless to try to produce anything like handles, tops, etc., that are made *in quantities*. I turned eighty rings for curtain-poles when going into a new house, and then found I might have bought them for less than I paid for the wood! That is because manufacturers buy wholesale and set boys to work at them on steam lathes, and the *work* costs almost nothing. The only thing I see for you would be to make friends with some neighbouring carpenters or cabinet-makers, who require at times little jobs of turning or fret cutting done sometimes, and do not care to take them far. That sort of thing would pay you, and be a convenience to them. But then, of course, "dabbling" won't do; you must learn a trade before you can exercise it.—F. A. M.

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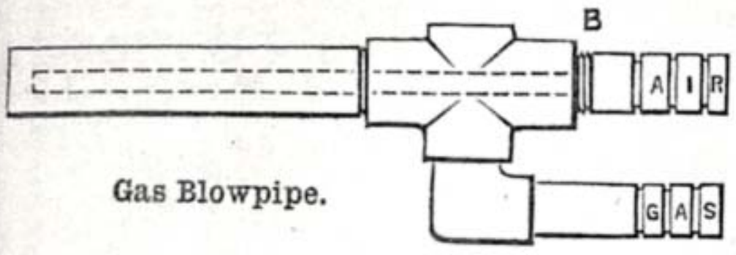
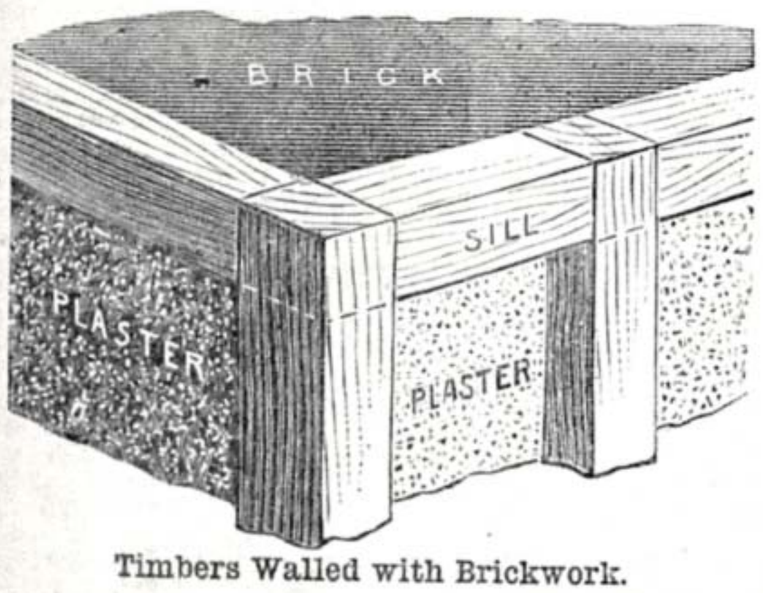
Gas Blowpipe.—CONWAY.—To make a blowpipe of the kind you require is not a very difficult matter. I send you a diagram of one that you can make with very little expense. To make it, you will require a ¼ iron gas T, a ¼ nipple, a ¼ elbow, and three pieces of ¼ tube, a brass boss, such as are used in the ends of picture rods to screw the knob in, and a few inches of ⅛ brass tube. To put it together, take the three pieces of tube, which may be of the following lengths: one piece 5 in. long, and two pieces 3 in., all to have a thread on one end; take the brass boss and solder it in the thread end of one of the short pieces (of course, filing and



Gas Blowpipe.

cleaning the iron pipe inside first); screw the piece of ⅛ brass tube into the brass boss, and if you like it can be soldered in, as no heat to speak of comes back to that part; next screw this short piece of pipe with the brass jet into the T-piece, and screw the longest piece of pipe into the other end; the end of the brass jet should be ¼ in. from the end of the iron pipe; next screw the nipple into the outlet of the T, and the elbow on to that; lastly, screw the remaining short piece of pipe into the elbow, and this completes the affair. You will find this will braze the small things you require, but you will hardly have lungs strong enough to keep up the blast of air that will be required, and will want a foot-blower to work it efficiently. In the sketch, B shows the position of the brass boss, and the dotted lines the air jet.—R. A.

Design for Cottages.—J. C. E. (*Whitchurch*).—You will find by referring to the plans (see page 289, Vol. II., WORK) that the scullery is the same width as the kitchen, viz., 12 ft., and the length 12 ft., but you can please yourself what size you make it; but I think the scullery would be more useful if it was a little larger, because the greater part of the housework is done in this room. The wood pillars which support the roof or verandah are turned, to make them have a better appearance, and the feet of the same is fixed into an iron shoe which is let into the stone coping, and cemented to the 9 in. brick wall as shown in drawing. The width of the verandah is 7 ft. clear between the brick walls; the width of the hall is also 7 ft. clear; the dimensions of timbers for the half timber work 6 in. by 6 in. for the uprights and diagonals, 12 in. by 6 in. for sills and bressummers. The moulded beam should be



Timbers Walled with Brickwork.

14 in. by 12 in., all timbers to be walled into the brickwork, as shown in sketch. All the exterior walls are 14 in. in thickness, and the internal ones are 9 in.; but if you want to build on the cheap, you may have your external wall 9 in. instead of 14 in. thick, and your internal ones 4½ in. It would be better to pave the hall and scullery, as well as the kitchen, with red and black Staffordshire flooring tiles, but it would not be cheaper than flooring boards, because, as you will see, flooring tiles require a bed of good 6-in. concrete under them, and to be grouted over with cement when finished.—W. B.

Bending Beading.—IMPROVER.—To bend your brass beading-bore a hole in a piece of wood about 1¼ in. thick, fix it tightly in the vice, slip the bead in the hole, and gradually bend to the shape required. I use the tool holes in my bench for bending beads of ash-pans, etc., and can manage very well; but the round hole is the better plan; it should only be a little larger than the beading.—R. A.

Coal Bunker.—DITTON.—Will this querist be a little more explicit? Does he want a coal bunker in metal or wood? Is it to be ornamental in any way, or simply utilitarian? What space is available for its reception, and how much is it required to hold? If our readers in asking questions would only give a few details, it would save us many a half hour's puzzling to find out what is really wanted. It is useless to fill up the columns of "Shop" with sketches and information that after all may be of no use to the querist or anyone else.—R. A.

Tool, etc., Chest.—HUGH.—I am pleased you have made my "Combination Bedroom Suite," No. 26, and "Hat-Stand and Hall-Seat," No. 44. I have designed the chest shown. Your wife can conveniently use the lower cupboard (or drawers could be substituted). Not knowing how many tools you possess, I hardly know how to distribute accommodation for them; but, presuming it is not a small stock, I have intended that the upper half of chest shall be for your use. You will see that the way in which the top opens will prove serviceable. If you had merely a tray to draw in and out, you would seldom fill the space so full as to occupy that amount of it which the tools on the under side of the flaps would when the latter were lowered. The arrangement of the holders must be left to yourself;

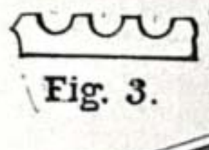


Fig. 3.

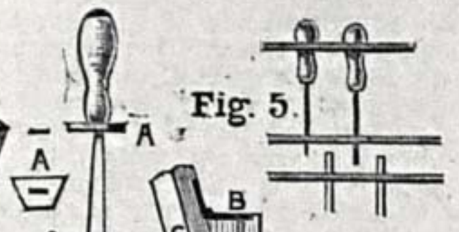


Fig. 4

Fig. 5.

Fig. 6.

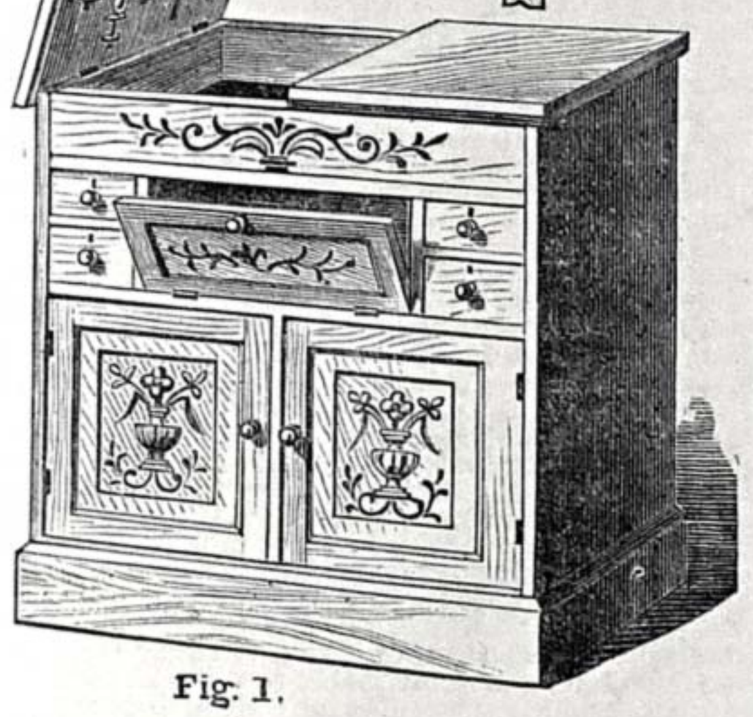


Fig. 1.

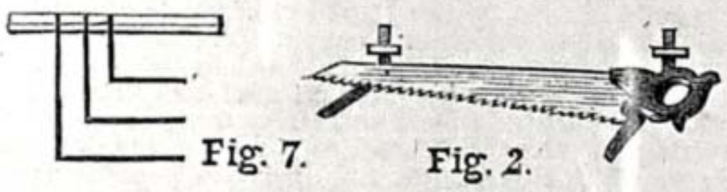


Fig. 7.

Fig. 2.

Fig. 1.—Chest Complete. Fig. 2.—Way to support Saws in Top Compartment. Fig. 3.—Elevation of Tool-holding Gallery. Fig. 4.—A, A, A—Tool Holders for Top Flaps. Fig. 5.—Plan of Galleries. Fig. 6.—Explained below. Fig. 7.—Side Elevation of Saw Holders.

Explanation of Fig. 6. If Rails (B) are screwed to sides of Chest (D) at top, flush with remaining edges, and wider than the thickness of sides, also with bevelled outside edge, Flaps (C) can be so hinged that when open they may remain so. Suitable dimensions: Width and height each 3 ft. 6 in.; depth from back to front, 18 in.; other parts proportionately.

but I advise you to place them as in Fig. 4, according to the kind of tool to be held. The way in which the lower holder projects, being so near the edge or point, would tend to prevent any accidental contact with tools in the box portion of chest. In the latter it will be best to arrange a series of galleries as in Figs. 3 and 4, the shape and size of each hole corresponding to the handle, etc., of tool, so that they may lay as there shown. I have shown four drawers for nails, etc.; and between them a cupboard for small saws and other tools. The saws could be laid at back on square hooks as in Fig. 2. Fig. 7 shows side view of supporters arranged in order that the saws may be stowed one above another. I should prefer to make chest in mahogany. Suitable dimensions are given in the inscription under cuts.—J. S.

Steam Engine Governors.—F. H. (*Peckham, S.E.*).—Your idea is to make the position of the balls independent of the throttle, and so get isochronism of the governor. But let us see what happens. Your engine is racing: the balls fly outwards; wheel C comes into gear with B, and the throttle closes, slowing down the engine; the balls then descend, wheel A comes into gear, and the throttle opens, quickening the engine speed, and this action is in effect just the same as that of a common governor. Your error lies in supposing it possible to obtain isochronism in any common pendulum governor. In order to perfect isochronism, the number of revolutions of the balls should be the same for all heights of their plane of revolution, which means that their weights should be variable. If the centres of the balls were in a parabolic arc, the governor is isochronous. But perfect isochronism is useless in a governor, making it too sensitive for practical purposes, hence the use of weights and springs in governors that are approximately isochronous in their mode of construction.—J.

Hooks for Shoe-Laces.—CRISPIN BARNETT.—The best paper devoted to the boot and shoe trade is the *Boot and Shoe Trades' Journal*, 9 and 10, St. Bride's Avenue, Fleet Street, E.C., price 2d. every Saturday. This paper used to be called *St. Crispin*, I do not know of the *Cordwainer*; Sell's "Directory of the World's Press" does not give it. Then there is the *Record*, 1d. per week, and *Leather*, 4d. per month. The best hooks in the market are Daude's eyelet hook (Fig. 1), from 1s. 4d. to 1s. 8d. per box of

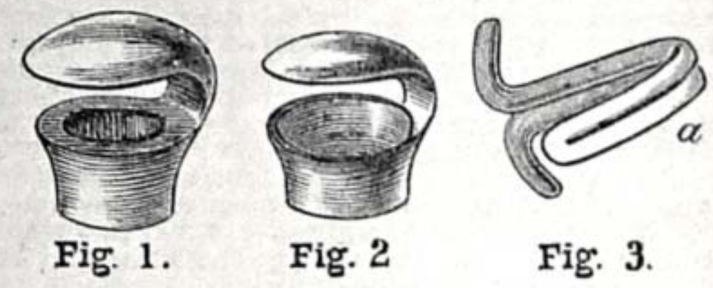
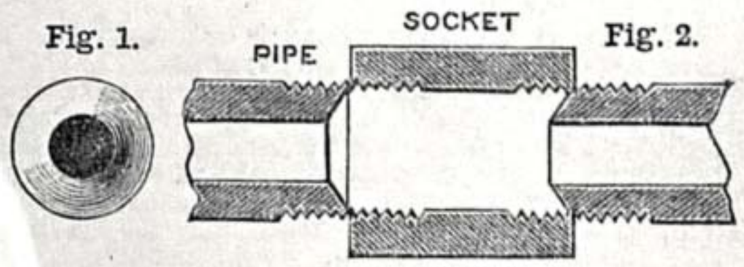


Fig. 1. Fig. 2 Fig. 3.

Hooks for Shoe-Laces.

500, and rings to make them secure at the back, 3d. per box of 1,000. Bray's patent lacing stud (Fig. 2) is a good hook, but it requires a machine to put them in with, the cost of which is £1. The studs are 3s. 11d. per 500. There is another—perhaps the one of which you speak (Fig. 3)—but it is not much used now, only for strong work, where leggings are worn, as all the strain is on the curve (*a*, Fig. 3), and when worn a little opens, and catches in the bottom of the trousers. Daude's is what is used in the West End of London for all the best work. They can be procured at Mark Deed's, High Street, Bloomsbury, W., or Penton & Son's, 1 and 3, Mortimer Street, London, W.—W. G.

Perkins' Hot-Water System.—A. H. F. (*Cheltenham*).—This system of hot water is for heating only, and it is a high pressure system; I am glad to be able to give you some information about it, but I must also tell you that unless you are a practical mechanic, and with a good knowledge of hot-water fitting, its principles as well as practice, that you had better let Perkins' system alone: it is quite out of the run of ordinary hot-water work, as special tools and appliances are required. The pipes used are Spencer's patent tubes: they are very thick, and of small bore. Fig. 1 shows end section of the smallest size; it is ⅝ bore; the other size—for only two sizes are used—is ⅞ bore, and the thickness of the pipe is about ⅜. No boiler is used in this system, but instead there is a coil of pipes which answers the same purpose. No elbows or bends are used in fitting up the system: all bends are made in the pipes on the job, and the T's are also made on the job by welding and drilling out the hole with a Morse bit. The way the pipes are connected is as follows:—The pipes have a right-hand thread at one end, cut with right-handed stocks and dies, and at the other end a left-handed thread cut with left-handed dies; the special sockets have a left- and right-handed thread to correspond. The ends of the pipes are prepared before screwing together, as follows (see



Hot-Water System. Fig. 1.—End Section of Spencer Tube. Fig. 2.—Sectional Drawing, showing Method of connecting Spencer Tubes.

Fig. 2):—One end being filed off square and true and then countersunk, and the other bevelled off on the outside to match, both pieces are brought up to the socket and the socket is screwed on; turning the socket one way thus screws it on to both pipes, and they are drawn close together, metal to metal. No red lead or anything of the sort is used, the pipes are screwed very tight with extra strong tongs with long levers, two men generally giving the last pull. The pipes can be carried anywhere: no regard need be paid to getting them level, as in low pressure systems. There is a small cistern at the top of the range of pipes with a valve that keeps closed while they are under pressure. The pipes are filled and subjected to a pressure of several hundred pounds to the square inch by means of a force pump connected to a steam tap near the coil; a Bourdon pressure gauge indicates the pressure, and, when sufficient, the tap is turned off and screwed down very tight, and a gentle fire lit up to test. The greater the pressure the more rapid the circulation. The pipes have been known to get so hot as to scorch a lady's dress, and to scorch the paper on walls. The pressure on a kitchen boiler with a supply 40 ft. high is 20 lbs. to the square inch. The rule for calculating pressure of this kind is very simple: a height of 32 ft. gives a pressure of 15 lbs. per square inch, or, as near as possible, 2 lbs. to the foot in height. Any further information on hot water with pleasure, and sorry your queries have miscarried; you may, however, depend it was from no want of courtesy to you.—R. A.

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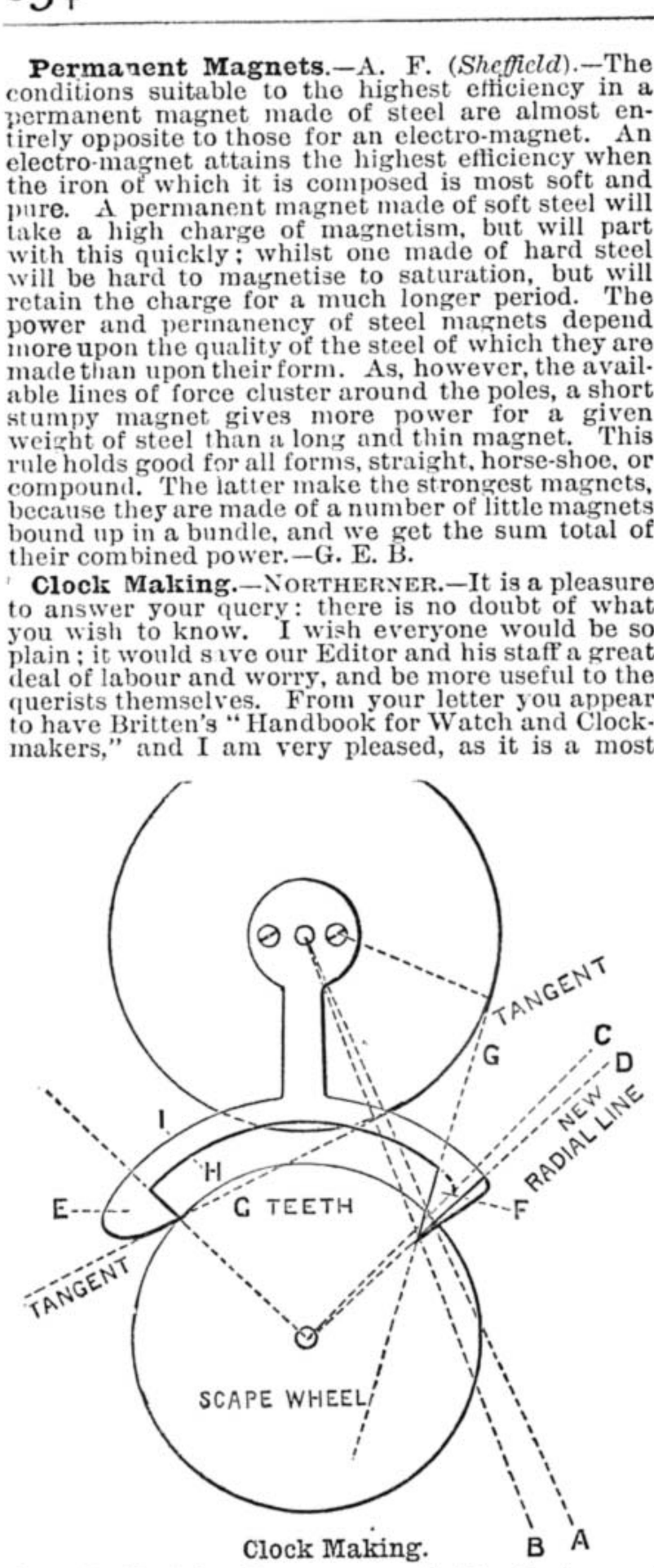
Permanent Magnets.—A. F. (*Sheffield*).—The conditions suitable to the highest efficiency in a permanent magnet made of steel are almost entirely opposite to those for an electro-magnet. An electro-magnet attains the highest efficiency when the iron of which it is composed is most soft and pure. A permanent magnet made of soft steel will take a high charge of magnetism, but will part with this quickly; whilst one made of hard steel will be hard to magnetise to saturation, but will retain the charge for a much longer period. The power and permanency of steel magnets depend more upon the quality of the steel of which they are made than upon their form. As, however, the available lines of force cluster around the poles, a short stumpy magnet gives more power for a given weight of steel than a long and thin magnet. This rule holds good for all forms, straight, horse-shoe, or compound. The latter make the strongest magnets, because they are made of a number of little magnets bound up in a bundle, and we get the sum total of their combined power.—G. E. B.

Clock Making.—NORTHERNER.—It is a pleasure to answer your query: there is no doubt of what you wish to know. I wish everyone would be so plain; it would save our Editor and his staff a great deal of labour and worry, and be more useful to the querists themselves. From your letter you appear to have Britten's "Handbook for Watch and Clock-makers," and I am very pleased, as it is a most

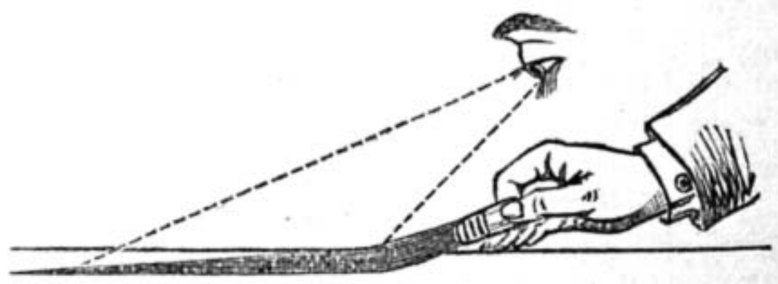


Clock Making.

Rough Sketch of Escapement, the Centres of 'Scape Wheel and Pallets being out of the usual Proportion.

useful book to anyone, amateur or otherwise, I think. Now to draw your pallets: proceed exactly as he says on page 9, *excepting that you mark the exact distance of your centres of 'scape wheel and pallets, and work from that instead of the distance he gives, viz.*, radius of 'scape wheel by 1·4 (of course in new work you would use his measurements). Having done that, you will find that the leading pallet, marked E in sketch, would come out all right; but pallet F would be nothing, or next to it. Now, having drawn the impulse line A, mark off four degrees inside, as dotted line B; next draw radial line D from centre of 'scape wheel through the tangent line G, where it crosses the impulse line B. You will now find you have a good pallet at F equal to the one at E. I trust, from the above and the rough sketch enclosed, you will understand my meaning. Some years ago I encountered the very same thing as you, and was completely fogged how to proceed until a friend, who is a great authority on horology, instructed me as above, and since then, whenever I require to make pallets for *jobbing purposes*, I have followed this rule, always with the best results, always using the distances of the depth on the plates instead of the measurement 1·4 of the radius of 'scape wheel. Allow me to also give a hint: make all these drawings on a piece of zinc, and cut out the pallets as drawn; fit them on the verge, and test them; alter, if necessary, till they escape all right, and make your pallets from it. I find that the easiest way, and best in the end, for if spoilt it is easy to make another, time and material being nearly nil. Now I shall take it as a favour if you will communicate the result—in fact, if all would do that we should know better how to assist others, or whether our advice and instructions were intelligible or not, as sometimes I may forget I am telling one who has not the experience of one who has learnt the trade. You wish also for hints as to shaping and tempering; I always, or nearly so, draw the lines H and I from the centre of scape wheel; the other parts, I think, are merely a matter of taste; but as to the acting faces, round them, as Britten says, and the better they are polished of course the better for the clock. As regards tempering, I always make just the pallets (E and F only) very hard, and leave them so. As regards the castings, etc., for a clock, you cannot do better than send to J. Mayes, 55, Red Lion Street, Clerkenwell, E.C. I can confidently recommend him, as I have had a great number from him; write and say what you require, enclose addressed and stamped envelope, and I feel certain you will get it; the price I cannot say, not at present being able to put my hand on any accounts. I shall be pleased, indeed, to give any further information on this, or any other, job, either in WORK or privately through the post; in case of urgency, the Editor will forward any letter no doubt; we all owe him our best thanks. I have learnt many things from WORK, and trust others have done so.—A. B. C.

Fine-Lining 'Bus Panels. NOVICE.—The failure to draw a straight line with a pencil and colour may result from unsteady nerves, defective vision, fumbling manner of holding the pencil, or faulty positions of the guiding fingers, etc. Or the colour may be badly mixed, the ground-colour surface not rightly prepared to receive the line-colour, or the "lay" of the pencil and starting at each dip of colour may make a gouty line. You must cultivate a faculty—*i.e.*, "deliberation." The first thing you have to do is to study such positions of work in relation to the horizontal level as will train the eye, fingers, pose of body to the many possible positions of a painter at work. The first lesson I once gave a youth was with the microscope—the object lesson: single hairs of different animals, including camel, sable, fitch, lynx, ox, hogs' bristles, etc.; he learned the peculiar formation of different hair, and the overlapping scales which cover them, and that it is these scales which hold the colour, and yield it under pressure by the law of adhesive attraction—not capillary attraction in this instance. This was to teach an impatient youth *deliberation*. Follow for yourself this method. Now for technique and science of manipulation and colouring, which terms are to be rendered by the homely words "touch" and "sense." The panel must have been flatted down with fine pumice-dust to a dull egg-shell dimness of surface: this is essential. Now bear in mind that you should be able to use the left and right hands equally well; if you cannot, put the left hand to do a lot of easy short lines; for to be a painter, the left hand must be taught up to the right-hand mark. Next, as a learner, mark the line at the right distance from the moulding: this is by a pair of compasses, wash-leather on one point, and a finely pointed piece of charcoal, chalk, or suitable soft substance, on the other. This will give you confidence that you are going straight; once you have that confidence, you will never want to use these mechanical aids for your judgment. The 'bus body is usually tilted up to an angle of about 45°; it is not fair to a learner to expect him to lay a line of colour on a vertical panel: that can be done with practice, and has to be done on surfaces horizontal above the painter's position. The moulding of the framing of the body guides the hand by those fingers of the hand not holding the pencil, using the moulding as a gauge-guide; the thumb and finger hold the pencil, the other fingers are kept rigid, but without any strain, and the pencil is drawn along the line with a graduated pace, slightly quicker at first, while the colour flows freely and slower at last, to enable the smaller supply of paint to escape from the hair, in which it is aided by the adhesion of colour drawing it from the pencil, as well as by pencil-pressure on the panel. I asked an expert and prize-winner of painting of the Polytechnic Institution to supplement my remarks by his experience, which he did. Charles Witham, the writer of the following, is a most efficient teacher, if one be wanted by a learner:—"It requires a steady hand, and the hand must be guided by the eye, as shown in sketch. The eye is first directed to the point of the pencil; when that touches, the eye should follow to the butt or the heel of the



Lining Tool.

pencil, and there rest until the line is finished. Confidence is a great thing in all pencil-work, which is obtained only by practice; when you lay the point of the pencil down and spread it out to the required width, which is done by the movement of the fingers as you lay the pencil level to draw, without stopping at a graduated pace, in drawing the pencil along unevenly it will cause the colour to flow more in some parts than others, thus making an uneven width in the line. When your pencil becomes empty, you must re-dip in the colour, then work it on the palette until the hairs of the pencil are even and straight: then you will not get too much colour in the pencil. As the colour becomes thick in the butt or heel of the pencil you must dip it in a little turps, which you have in a 'dipper' by you while you are at work, and work on the palette as before. If you were to use the pencil direct from the pot of colour on to the panel or spoke, you would get too much colour, and it would run all over the surface, and spoil the line. When you have re-filled the pencil to continue your line, do not start from the exact point at which you left off, but start a little way back on the line, or else the connecting line will be smaller and uneven in colour, unless thus retraced, the paint being less in quantity towards the last 'lay off,' and it will not cover the ground colour solidly. On 'busses, as a rule, it is the mouldings that are picked out gold, black, etc., with ⅛ or ¼ line of another colour on the edges, or sometimes ½ in. away from the moulding on the panel; but the distance may be as much as 4 in. from the moulding, the little finger forming the gauge-guide of the hand. Success is progressive; do not attempt a line 8 ft. long till you can do one a foot long well; now and then practise on old panels, short lengths, and vary the straight line with curves, which are more difficult." Varieties of pencils for lining and striping, or bands, are made of sable, camel's-hair, Siberian ox-hair, etc.; the best are sable, of which there are two kinds, the red and the black, either of these will make good stripes, but the red hair is mostly used for ornamenting panels. Camel's-hair is softer, but does not do for heavy colours, such as vermilion; the sable ox-hair is the best for heavy colours; the camel's-hair is best for blacks, chromes, or whites; this hair being softer, it holds more colour, and levels better. One word, not about painting, but essential to success—cleanliness of shop, tools, and person; a clean painter commands ready work, and keeps his place and health; a dirty painter risks losing both.—J. C. K.

Small Tubes or Sockets, etc.—X. Y.—I cannot advise you how to make a machine to turn and punch the sockets you require. I should think that the best thing you could do would be to get one of Rhodes' small tube bending rollers, of which I send you a sketch (Fig. 1), from which, if you like to try and make one, you can. For my

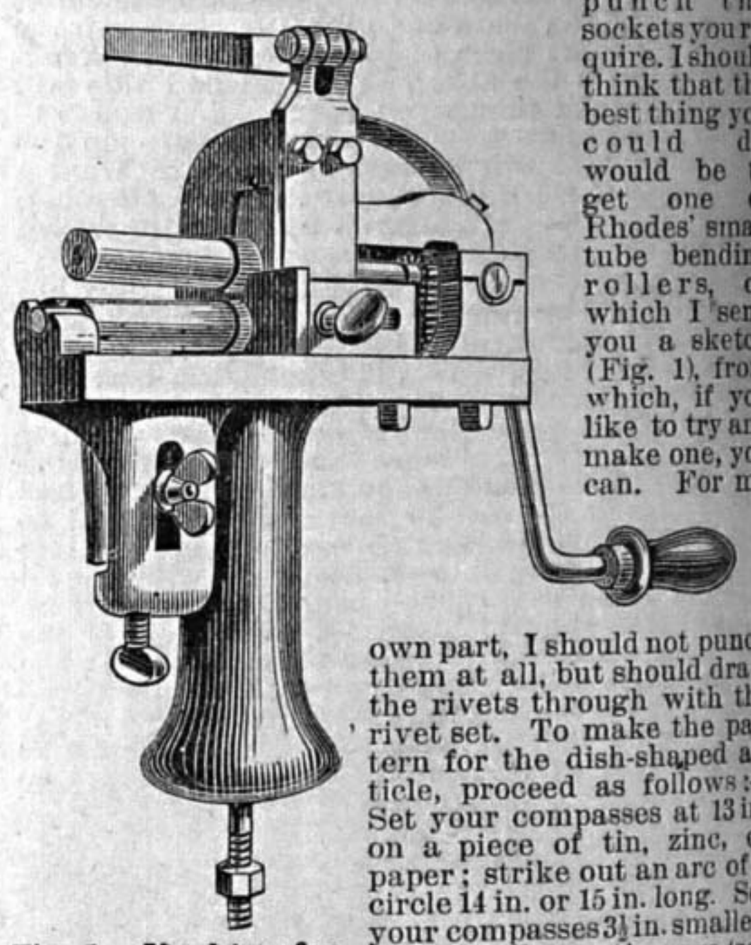


Fig. 1.—Machine for forming or bending Small Tubes or Cylinders, with or without Bead, 6 in. long, 1 in. and upwards in Diameter.

own part, I should not punch them at all, but should draw the rivets through with the rivet set. To make the pattern for the dish-shaped article, proceed as follows:—Set your compasses at 13 in. on a piece of tin, zinc, or paper; strike out an arc of a circle 14 in. or 15 in. long. Set your compasses 3½ in. smaller, and describe another arc (see Fig. 2). On the top line set two points, A and B, 12½ in. apart, and from these points draw lines toward the centre C; the figure contained within A, B, D, E will be the pattern you require; allow ¼ in. each side for the seam. Now as to working it up: the reason it cracks as you turn the edges is, I expect, because you draw it over too suddenly, and do not humour the stuff enough, or else you have bad tin. I should advise you to wire the small part before turning round, then work the gold for wiring the top (Fig. 2) very gradually, using first a flat tool and a broad pane hammer, and stretching the stuff a little on the outside edge, then finish on the half moon stake; if this fails, then wire both top and bottom before turning. To make your hatchet copper bit you must work it at a cherry-red heat, and to make the nick round it, as shown in your sketch, use a bottom tool and fuller, and get someone to strike for you; draw down the hatchet part last.—R. A.

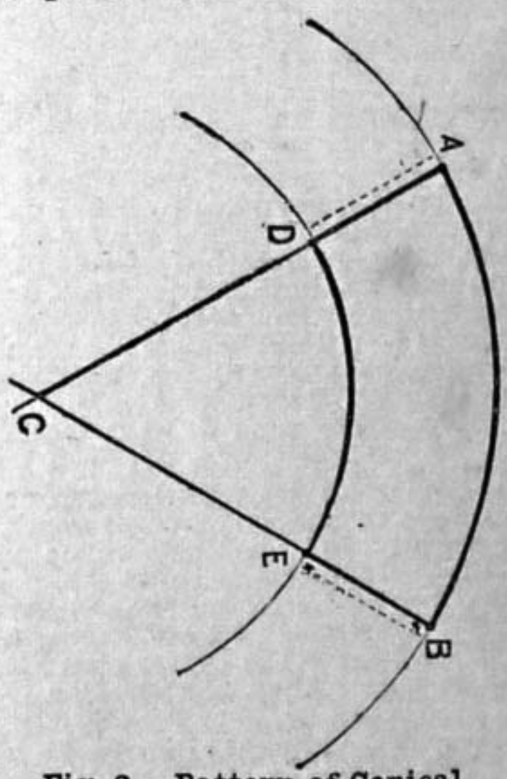


Fig. 2.—Pattern of Conical Article.

American Organ Fittings.—AMATEUR.—For all parts of these instruments, for own building, you will do well to apply to the American Organ Fittings Co., 2, Oseney Crescent, Camden Road, N.W. Papers on the subject are in hand, and will probably appear in Vol. III.

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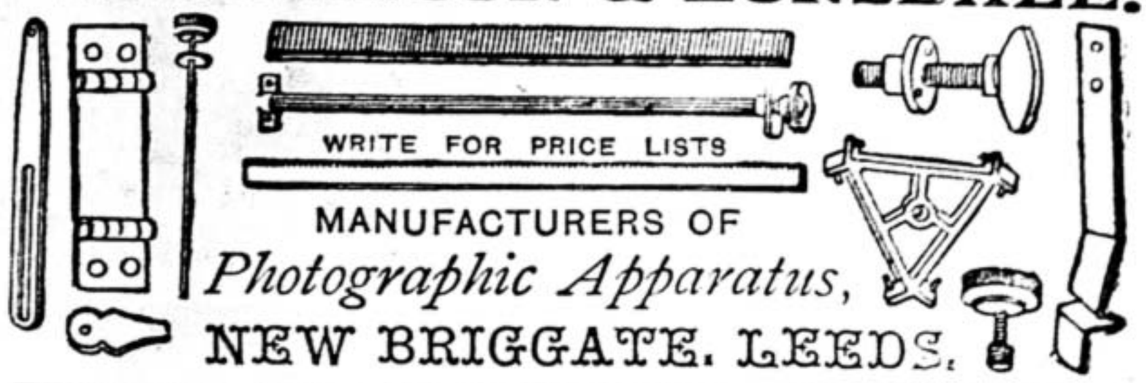

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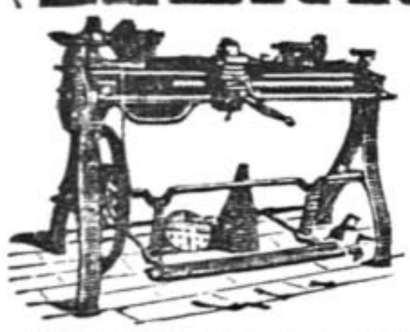

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